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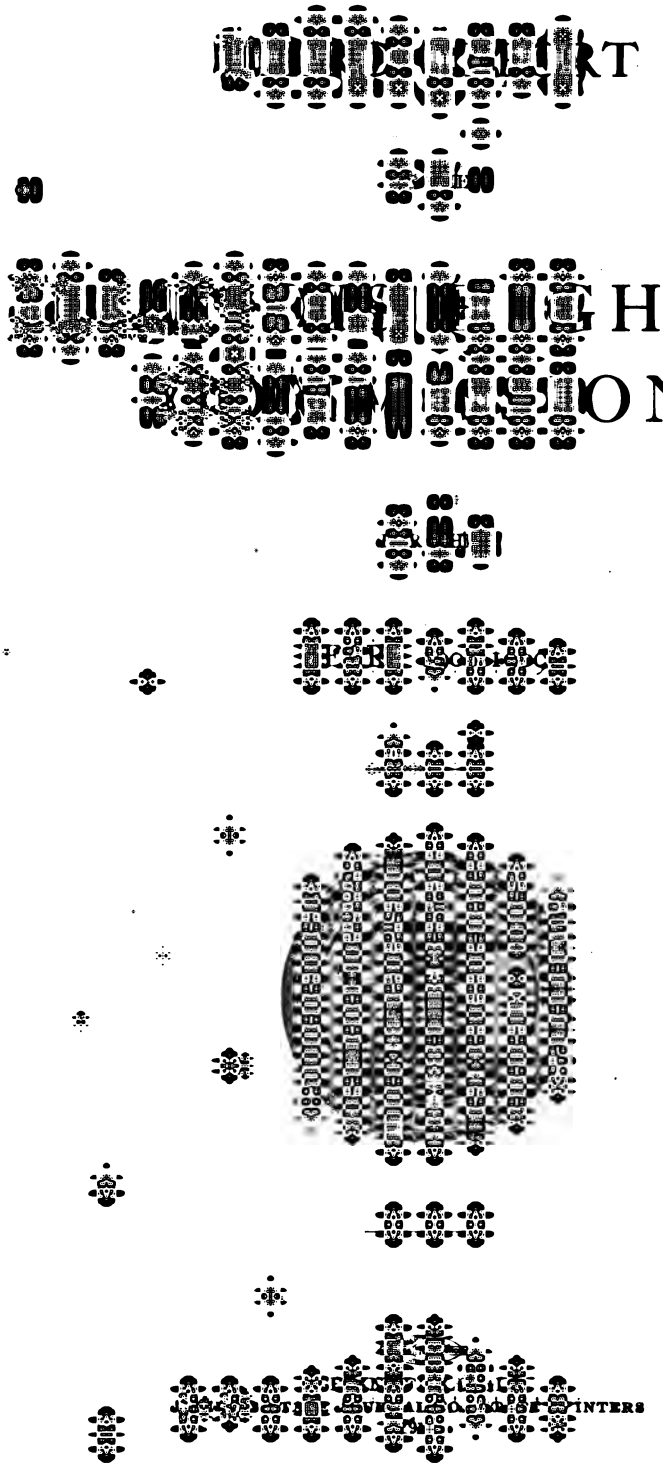

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ILLINOIS HIGHWAY COMMISSION.

EDMUND J. JAMES, *Chairman,* Urbana.
JOSEPH R. FULKERSON, Jerseyville.
LAFAYETTE FUNK, Shirley.

A. N. JOHNSON, *State Engineer.*

CONTENTS.

	PAGE.
List of Illustrations	7
Letter of transmittal	9
Introduction and Summary	11
Resolution of Illinois State Farmers Institute	11
Local Roads	13
Main Roads	13
Width of Roads	14
Cost of Road Improvement	14
Road Systems	14
Pleasure Roads	16
Present Cost of Maintaining Public Highways	17
Meetings Attended	21
Earth Roads	26
Better Earth Roads are possible	26
Principles of Construction	27
Best Methods require a little work done often	29
Drag the Roads at all Seasons	30
Crushed Stone prepared at the penitentiaries	32
Convict Labor on Road Material	32
Revised Law concerning the use of free macadam	33
Distribution of crushed stone prepared at penitentiaries	33
How to apply for Crushed Stone	34
Experimental Roads	41
Instructions to Road Inspectors	42
Average Labor Cost of Macadam Construction	43
Thickness of Macadam	44
Width of Macadam	45
Maintenance	45
Cost of Macadam Roads	46
Methods of Construction	47
Experimental Roads Constructed in 1908	50
South Road, Central Township, Bond county	50
Fourth Street Road, Central Township, Bond county	50
English Settlement Roads, Orland Township, Cook county	51
Chicago-Batavia Road, Milton Township, DuPage county	52
Efner Road, Sheldon Township, Iroquois county	54
Washington Street Road, Mendota Township, LaSalle county	55
Mazon Avenue Road, Dwight Township, Livingston county	56
Trenton Road, Helvetia Township, Madison county	56
Sebastapol Road, Helvetia Township, Madison county	58
Masonic Home Road, East Nelson Township, Moultrie county	58
Lesure's Lane Road, Danville Township, Vermilion county	60
Cemetery and Fair Grounds Roads, Carmi Township, White county	61
Elwood-Symerton Road, Florence Township, Will county	63
Joliet-Lockport Road, Lockport Township, Will county	64
Experimental Roads Constructed in 1909	65
West Cross Street Road, Mt. Sterling Township, Brown county	65

Contents—Concluded.

Experimental Roads—*Concluded.*	PAGE.
Flossmoor Road, Rich Township, Cook county	67
Geneva and Claire Roads, Sycamore Township, DeKalb county	69
South Morris Road, Wauponsee Township, Grundy county	72
Cemetery Road, Galva Township, Henry county	74
Cemetery Road, Middleport Township, Iroquois county	75
Fieldon Road, English and Jersey Townships, Jersey county	76
Lily Lake Road, Blackburn Township, Kane county	78
Bailey's Lane, Yellowhead Township, Kankakee county	79
North Road, Yellowhead Township, Kankakee county	81
Mazon Avenue Road, Dwight Township, Livingston county	82
Hurst and Davis Street Roads, Bushnell Township, McDonough Co	84
Troy & West Street Roads, Edwardsville Township, Madison county	86
Collinsville-Troy Road, Collinsville Township, Madison County	88
Tri-City Road, Venice Township, Madison county	89
Walnut Street Road, Olney Township, Richland county	92
Independence Road, Harrisburg Township, Saline county	93
Oiled Earth Roads	95
County Club Road, Woodside Township, Sangamon county	96
Ivesdale Road, Bement Township, Piatt county, Section 1 constructed in 1908	98
Ivesdale Road, Bement Township, Piatt county, Section 2 constructed in 1909	99
The Naperville experiment	100
Use of Bituminous Compounds in Macadam Road Construction	105
Report of Bitumens used in 1909	109
Bridge Work	112
Bridge applications should be made in the fall and winter	112
Concrete Bridges	113
Some Cost Data for Reinforced Concrete Bridges	119
Method of Design	119
Character of Concrete	121
Forms	122
Discussion of data	122
Opinions of the Attorney General	135
Commissioners of Highways: Pay, Powers, Meetings, Vacancies and Liabilities	135
Dragging Roads	143
Drainage	143
Hard Roads	145
Laying out; narrowing roads: and fences	147
Taxes, Levies, Expenditures and Bonds	150
Town Line Roads and Bridges	153
Traction Engines	155

List of Illustrations.

PLATES.

		Facing Page.
1.	Frontispiece	11
2.	A. Condition of an earth road in September	26
	B. The Road Drag at work	26
3.	A. Form of drag suitable for sticky soils	28
	B. Effect of slicker on black, gumbo soil	28
4.	A. A dragged road with row of loose material at center	30
	B. Grass and weeds growing in center of road and two lines of traffic formed at sides	30
5.	A well built earth road	32
6.	A. Braceville Township, Grundy county. Road constructed without a roller with insufficient top dressing	34
	B. Ganier Township, Kankakee county. Road constructed without the use of a roller	34
7.	A. Orland Township, Cook county. English Settlement road before improvement	52
	B. Orland Township, Cook county. English Settlement road after improvement	52
8.	Naperville experimental road, DuPage county. Slag macadam, asphaltic binder	64
9.	Naperville experimental road, DuPage county. Old road, loosened and surface made with asphaltic oil	68
10.	A. Waterbound macadam made with Joliet penitentiary limestone. Note raveling and compare with cut B	74
	B. Waterbound macadam made with Joliet penitentiary limestone and covered with sandy loam	74
11.	A. Hauling stone with special hauling outfit. Capacity, each wagon, 7 yards	78
	B. Fieldon road, Jersey Township, Jersey county, after improvement	78
12.	A. Collinsville-Troy road, Collinsville Township, Madison county, after improvement	82
	B. Edwardsville-Troy road, Edwardsville Township, Madison county, after improvement	82
13.	A. Independence road, Harrisburg Township, Saline county, before improvement	84
	B. Independence road, Harrisburg Township. Saline county, after improvement	84
14.	A. Joliet-Lockport road, Lockport Township, Will county, before improvement	86
	B. Joliet-Lockport road, Lockport Township, Will county, after improvement	86
15.	A. Tar Macadam Construction. Tar heated in tank car by steam and loaded into distributing wagon by air pressure	104
	B. Tar Macadam. Spreading tar from distributing wagon by hand	104
16.	A. Tar Macadam. Spreading from distributing wagon through a nozzle by steam pressure.	106
	B. Tar Macadam. Rolling newly tarred macadam	106
17.	A. Tar Macadam. Typical appearance of one course treatment	108
	B. Tar Macadam. Typical appearance of two course treatment	108
18.	Tar Macadam. West Cross Street, Mt. Sterling, Brown county, two course treatment	110
19.	A. Hamel bridge, Hamel Township, Madison county, before reconstruction	112
	B. Hamel bridge, Hamel township, Madison county, after reconstruction	112
20.	A. Frette bridge, Patton Township, Ford county, before reconstruction	118
	B. Frette bridge, Patton Township, Ford county, after reconstruction	118
21.	A. John Lawson bridge, Western Township, Henry county. Designed by the Illinois Highway Commission	120
	B. Leuthmeier bridge, Smithton Township, St. Clair county. Designed by the Illinois Highway Commission	120
22.	Mud Creek bridge, Manhattan Township, Will county	122

List of Illustrations —Concluded.

PLATES—*Concluded.*

Facing Page.

3. A. Reinforced concrete bridge construction under the supervision of the Illinois Highway Commission. Abutments completed and false work ready for superstructure..... 126
   B. Reinforced concrete bridge construction under the supervision of the Illinois Highway Commission. Reinforcing steel in place..... 126
24. A. Reinforced concrete bridge construction under the supervision of the Illinois Highway Commission. Forms partially removed..... 128
   B. Reinforced concrete bridge construction under the supervision of the Illinois Highway Commission. Details of falsework to support a 60-foot concrete bridge..... 128
25. A. Henry bridge, Cornwall Township, Henry county. Designed by the Illinois Highway Commission..... 134
   B. Andrew Swanson bridge, Walnut Grove Township, Knox county. Designed by the Illinois Highway Commission..... 134
26. Klattenhoff bridge, Colona Township, Henry county. View before reconstruction showing old timber structure..... 136
27. Klattenhoff bridge, Colona Township, Henry county. Designed by the Illinois Highway Commission..... 138
28. A. Illinois River bridge at Ottawa, Illinois. View of roadway before reconstruction..... 140
   B. Illinois River bridge at Ottawa, Illinois, as reconstructed. Designed by the Illinois Highway Commission..... 140
29. Illinois River bridge at Ottawa, Illinois, general view of new bridge..... 142

FIGURES.

PAGE.

1. Typical Cross Sections for Earth Road Construction..... 28
2. Cross Section of Joliet-Lockport Road..... 64
3. Half Cross Section of Mt. Sterling Road..... 66
4. Half Cross Section, Block 1, Mazon Ave., Dwight..... 82
5. Half Cross Section Blocks 2, 3, 4, Mazon Ave., Dwight..... 82
6. Half Cross Section 16 ft. tar macadam, Hurst & Davis streets, Bushnell..... 84
7. Half Cross Section 12 foot tar macadam, Hurst and Davis streets, Bushnell..... 85
8. Cross Section Collinsville-Troy Road..... 88
9. Half Cross Section E. St. Louis Tri-City Road..... 90
10. Typical Cross Section Through Girder Reinforced Concrete Bridge..... 120
11. Longitudinal Section and Plan, 60 foot reinforced concrete girder bridge, 16 foot roadway..... 130
12. Cross Section 60 foot through girder bridge showing abutments..... 131
13. Details of reinforced 60 foot through girder bridge..... 132
14. False work and forms for 60 feet reinforced concrete bridge..... 133

LETTER OF TRANSMITTAL.

SPRINGFIELD, ILL., Dec. 1, 1910.

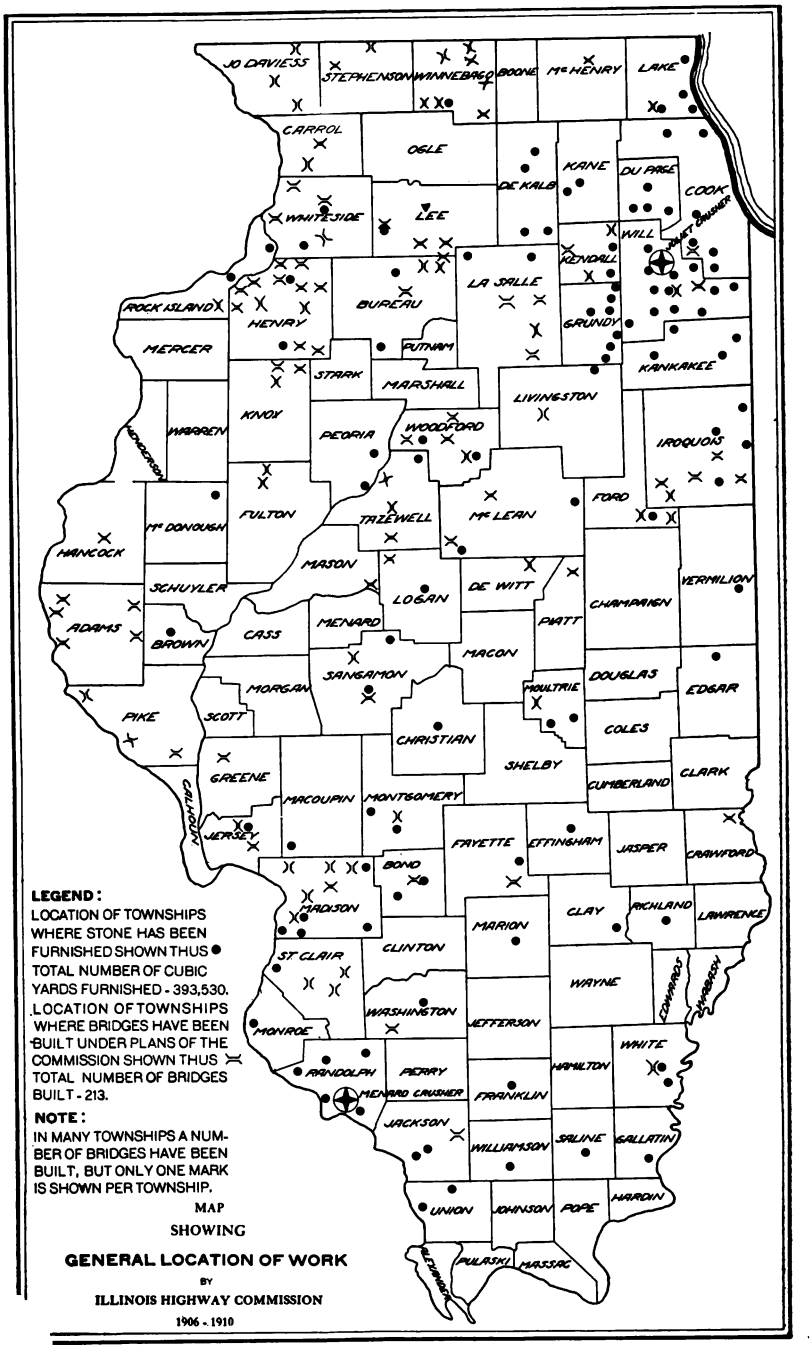
To the Honorable Board of State Highway Commissioners, Springfield, Ill.:

GENTLEMEN—I beg to submit herewith my report as engineer to the Commission on the work done during the years 1908-1909.

This report has been prepared in collaboration with Messrs. T. R. Agg and Clifford Older, in charge of road and bridge construction respectively.

Very respecfully,

A. N. JOHNSON,
State Engineer.



LEGEND:
LOCATION OF TOWNSHIPS WHERE STONE HAS BEEN FURNISHED SHOWN THUS ●
TOTAL NUMBER OF CUBIC YARDS FURNISHED - 393,530.
LOCATION OF TOWNSHIPS WHERE BRIDGES HAVE BEEN BUILT UNDER PLANS OF THE COMMISSION SHOWN THUS ⋈
TOTAL NUMBER OF BRIDGES BUILT - 213.

NOTE:
IN MANY TOWNSHIPS A NUMBER OF BRIDGES HAVE BEEN BUILT, BUT ONLY ONE MARK IS SHOWN PER TOWNSHIP.

MAP
SHOWING
GENERAL LOCATION OF WORK
BY
ILLINOIS HIGHWAY COMMISSION
1906 - 1910

INTRODUCTION AND SUMMARY.

The work of the State Highway Commission for the years 1908 and 1909 is here reviewed and the results commented upon in light of the experience gained during a portion of 1910, so that while the presentation of the reports for 1908 and 1909 has been delayed, it is believed nothing has been lost, and, in some particulars, considerable gained.

This report comprises statistics of amounts now spent on the roads and bridges, approximating six millions of dollars per year, chapters on earth road construction, macadam roads of various kinds, and highway bridges. In each of these chapters is given in detail a description and cost of the various methods of construction. When feasible, photographs have been used freely and as much of the story told in this manner as possible.

The demands made upon the Commission for assistance in road and bridge construction have steadily increased until a practical limit of the work it is possible to undertake with the appropriation at hand has been reached. The frontispiece shows how the work is distributed over the State. This general demand is in itself testimony of the confidence which the people are placing in the work of this department, and is well summed up in the resolutions passed by the State Farmers' Institutes at their annual meetings.

RESOLUTIONS OF THE ILLINOIS FARMERS' INSTITUTE RELATIVE TO THE STATE HIGHWAY COMMISSION.

1908.

WHEREAS, The State Highway Commission is doing educational work of wide value, and carrying on experiments in various kinds of road construction of service to all communities; and,

WHEREAS, Its assistance and results of its work have proved that it does save money to the taxpayers by securing improved roads and bridges; therefore, be it

***Resolved*, That the State Farmers' Institute in convention assembled again heartily commends the methods and work of the State Highway Commission and urges increased coöperation with it on the part of all local road and bridge officials.**

THE ROAD DRAG.

WHEREAS, The road drag, which has proven, wherever fully tried, a marvel in road improvement, and where aided by proper and adjacent farm drainage has gone far to solve the road problem; therefore, be it

Resolved, That we urge the road commissioners throughout Illinois to put the road drag in operation and to avail themselves of the law which provides compensation for interested farmers who would not otherwise use and know the wonderful results of this very simple implement.

1909.

WORK OF STATE HIGHWAY COMMISSION.

Resolved, That we believe county associations of highway commissioners and other officials interested in road and bridge construction should be organized throughout the State, and that we invite all such organizations to hold meetings in conjunction with the county farmers' institutes;

WHEREAS, The present hard road law limits to a small amount that which a township may expend upon road improvement; and,

WHEREAS, Many townships desire to build roads at a faster rate than the limit of the present law provides; therefore, be it

Resolved, That we favor such legislation as will amend the present law so as to permit a township to incur for road improvement such indebtedness up to the constitutional limit as the voters of a township may authorize by ballot.

WHEREAS, Reinforced concrete is a durable and economical material for the construction of bridges, inasmuch as the life of such bridges far exceed that of the ordinary steel or wood structures, while the cost of maintaining is practically zero; and,

WHEREAS, The State Highway Commission has designed and supervised the construction of about one hundred of these structures; be it

Resolved, That the building of concrete and reinforced concrete bridges and the use of concrete for the floors of steel bridges is hereby urged upon all local bridge officials.

WHEREAS, The production of crushed stone by the convicts at the State prisons has, from all viewpoints, proved on three years' trial to be an economical and practical success; and,

WHEREAS, Owing to the long freight haul, many sections of the State can get but little advantage from the present distribution of this free macadam material; therefore, be it

Resolved, That we favor the consideration of establishing additional quarries to be operated by the convicts.

WHEREAS, The State Highway Commission has expended wisely and for the good of the State the appropriation made for its use; be it

Resolved, That we reiterate our confidence in the State Highway Commission and urge upon the highway commissioners and supervisors throughout the State the closest coöperation with the State commission.

GENERAL METHOD OF CONSTRUCTION.

The general discussion of the work and conclusions reached by the State Commission may be divided in two general divisions—one dealing with the form of construction and cost of different classes and the other with general methods of administration to be adopted for systematic improvement of the highways of the State.

Local Roads.

It is evident that the side roads and purely local roads will, in a larger portion of the State, be earth roads, and to get the best results they must be maintained in a systematic, business-like way. This cannot be done until it is made one man's business in each locality to do this work all the time; not to have it done at odd times as personal convenience may dictate. Those who have given the question any close attention generally agree that it is no exaggeration to say that twice as much road work can be done under a business-like system and at no greater cost than is incurred by present methods. To get such results the work must be done when needed and in the right manner. The present law affords full opportunity to get such results, in that it is within the power of any board of road commissioners to appoint a superintendent who may have entire charge of the work and who should be on the work all of the time, devoting his entire attention to it. Where this has been tried and put into effective operation, the results have been nothing less than marvelous.

Main Roads.

The main roads carrying more traffic than the purely local ones should be improved in a more substantial way than is possible by any earth road maintenance. In some localities fairly good gravel is to be found, and, owing to its accessibility, makes possible the construction of fair roads at low cost. In general, however, it does not pay to transport gravel for any considerable distances.

Well built macadam will answer for many miles of roads for a good many years to come. Where sticky mud is liable to be carried on to these roads, or where there is a large amount of automobile traffic, it may be advisable to build bituminous macadam, that is, one which has a tar or asphalt binder. This character of construction also gives promise of being well adapted for residence streets in smaller towns on which there is no heavy traffic, and which it is desired to build at a small first cost.

Much detailed cost data and description of this form of construction will be found in a subsequent chapter. Aside from traffic conditions there are few or no roads in the State on which a durable macadam cannot be built at a reasonable cost.

There are to be found many stretches of roads on which the traffic is heavy enough to warrant the expense necessary to lay a brick pavement, and in fact any road carrying a large amount of automobile traffic can be improved in no better way. What may be done is first to construct good macadam roads, which, as the needs of the traffic show necessary, may later on serve as foundations for brick coverings, thus dividing the cost over a longer period than if the brick pavement was laid complete in the first instance.

Width of Roads.

It is evident that the width of a road is an important factor of its cost and that therefore to have the cost as low as possible, roads should have a minimum width. Practical experience has shown that for macadam construction, a width of twelve feet is as narrow as should be built, although ten feet may be justified in some instances. For brick roads the width may be somewhat narrower, but the minimum width should not be less than ten feet.

In the immediate vicinity of large towns, where there is much traffic in both directions at the same time, twelve feet is not wide enough to allow vehicles to pass, and the roads must be wider. Sixteen feet being a minimum width on which traffic can pass with reasonable comfort, or if there is much automobile traffic, eighteen feet should be the minimum.

Cost of Road Improvement.

What will be the cost of such construction? is the question asked by all. Every one will appreciate the impossibility of giving any exact estimate for a particular mile of road before the conditions are known; one mile may cost more than the average, others, less, but in general where the material will have to be shipped one hundred miles by railroad and where the average wagon haul is about two miles, a twelve-foot waterbound macadam road will average approximately $5,000.00 per mile; a tar or asphalt treatment will increase the cost from $1,000.00 to $1,200.00 per mile. Ten-foot roads will be almost, but not quite, proportionately cheaper. A ten-foot brick road where the material is to be hauled an average of about two miles, with a concrete base, would cost about $11,000.00 per mile, and approximately $1,000.00 per mile for each additional foot in width.

There will be many miles of road that can be constructed at less cost than these estimates; on the other hand, there will be many other miles, where the haul is longer, where heavy grading is encountered, which will cost more. But whether these estimates are considered high or low, the fact remains that communities all over the country have gone ahead on similar improvements that cost in many instances greatly in excess of these estimates, and that the investment has been found well worth making is evident by the increased amount of work of this character that these communities are doing each year, for it is manifest that no community would continue in a line of work which was not found to be well worth its cost.

The main features of construction of various classes of roads have been briefly discussed, the great majority of the roads being earth roads are to be maintained in a systematic manner; other roads according to the amount of traffic and the character of the traffic to be built in a substantial manner.

Road Systems.

The second division for road discussion included the general methods to be adopted in the systematic improvement of the highways. From

the great interest that is now taken in road work in Illinois, it is evident that some clearly defined plan should be outlined towards which the energies of all interested in such development should be bent that most may be accomplished.

First, there are what may be called bread and butter roads, that is, the roads leading from the various centers of trade to which the people round about naturally go for their supplies and to dispose of their crops. There are a number of these roads in every locality that are used sufficiently to warrant the investment necessary to construct them in a substantial manner. These would constitute a system of radial roads, and as soon as they had been built for four or five, perhaps six, miles, there would then be built cross roads or belt roads connecting them; and the natural extension of the radial roads, eventually connecting distant points, would complete trunk lines or through roads.

The radial roads and their eventual extension are the roads evidently most used and which would serve the greatest number of people, and are, therefore, the roads for which there is the greatest need of betterment at present. It is a fact, however, that there cannot be constructed in Illinois today a stretch of road of any considerable length without involving two or more townships, that although the stretch of road as a whole may be of the greatest importance to a particular locality, yet it may be of little concern to some one township in which a portion of the road may lie; thus there is at present no opportunity to have an entire stretch of road improved, even if the people served by this road should so desire. It must be evident that no system of improved roads that will answer present needs can be built or maintained under township units; the township unit is too small, and the fund that can be raised therefrom inadequate for the work.

There should be larger areas of control in order to plan and construct a system of roads such as is needed in practically every community. The county unit is the one that most naturally suggests itself, and with some exceptions would answer more nearly the conditions necessary for the development of a system of main roads than any other areas bounded by present political boundaries. It is therefore desirable to have such legislation as will authorize a county body to have control of the main roads and to have the county construct and maintain them. Such a law could be framed so that it would be operative in any county only after a vote by the people in that county; thus, those counties that desire to go ahead and improve their roads, would be able to do so, while those counties which, for one reason or another, were obliged to hesitate in taking up such a program would not be obliged to do so until the changed conditions made it feasible. Under such a plan the counties would have control of the main roads, including possibly 15 to 25 per cent of the total road mileage in the county, while the control of the merely neighborhood roads or feeders to the main system could remain in the hands of the various local communities, as at present. Thus roads that served only a small neighborhood would be kept up as the people therein saw fit or were able to do, while the roads serving several communities, or a larger center of population, extending through a wide area, could be constructed and maintained by the county as a whole.

Pleasure Roads.

There are still other roads to be considered in a comprehensive plan of road improvement. While they may be generally classed as pleasure roads, yet, in some cases, they may be quite as useful to the community as roads which are used more for business than for pleasure travel. There are parks in nearly every city of any size; in some cases these parks are of considerable expanse, but in general they are comparatively small in area. In the vicinity of many towns there are streams and rivers, along which are tracts of land, perhaps not particularly valuable at present, that could be secured, through which drives should be built, connecting with the parks that already exist, and, by this plan, extending park systems for considerable distances into the country, preserving the natural beauty along the streams and rivers for the enjoyment of those who are compelled to live in the cities. For instance, about Chicago such a system of roads would be of considerable extent, one along the Fox river, another along the Illinois river to the State park at Starved Rock, opening to the traveler over these roads some of the most beautiful country to be found in the State.

In the vicinity of Quincy, Rock Island, Peoria, Ottawa and many other cities there are possibilities for laying out roads which will command unsurpassed scenery.

Massachusetts has built park roads along the seashore, connecting with the inland woods and ponds; New York has built roads through the Adirondacks, opening the mountain scenery to all, and at no distant day Illinois may have miles of river drives which will prove a source of both profit and pleasure to her people.

PRESENT COST OF MAINTAINING THE PUBLIC HIGHWAYS.

In Table I will be found the amount of the road and bridge tax for each county of the State for the five years 1905 to 1909 inclusive. These figures have been taken from the tax reports as made to the State Auditor.

If the amount of road and bridge tax for 1905 as given in the report of the Highway Commission for 1906 is compared with the figures for 1905 shown in Table I, some discrepancy will be noticed. Therefore the returns as made to the Auditor for 1905 are published in order that strict comparison can be made with the expenditures in subsequent years. It is probable that larger amounts than those shown in the table are spent on the roads, as no account is there taken of the value of the labor tax nor of money received from other sources.

In connection with Table I it would be well to glance at Table II, which shows the amounts that have been voted during this same period exclusively for hard roads. Under the hard road law, a community may vote a certain tax to run for a period of one to five years for the construction of certain designated roads. Table II shows the total amount so voted during the five year period from 1905 to 1909 inclusive. Thus, if a township voted in 1909 $10,000.00 a year for five years, the table would indicate that $50,000.00 had been voted.

It will be noticed that there has been a gradual increase in the amount expended on the roads. The amount for 1909 being over five millions of dollars in cash tax. This, however, is not the total amount expended for roads and bridges. There are many bridges built for which the county pays one-half. The hard road tax and the cash value of the labor tax swell the total expenditures. The amount of county aid cannot be ascertained exactly, but it is estimated at not less than $250,000.00 per year. The hard road tax is estimated at about $300,000.00 per year; and the money value of the labor tax for 1905 has been estimated at $409,000.00. It was probably not so great in 1909, as there has been a general tendency for the townships to abandon the labor tax system for the cash tax. It is probable that in 1909 the value of the labor tax did not exceed $300,000.00. This brings the total cost of the roads and bridges in the State to a little over six millions of dollars per year. This amount is expended on the public roads of the State, of which there are

a little over 94,000 miles or an average of 1.7 miles of road for every square mile of area. In 1905 the estimated amount of road which had been graveled or macadamized was 7,864 miles or 7.7 per cent of the total mileage.

It is impossible to estimate with any exactness the number of miles of gravel or macadam roads that have been laid in addition to mileage here given. From 1906 to 1909 the State has distributed crushed stone which would build the equivalent of 300 miles. There are 112 townships in forty-one different counties that have voted for a hard road tax. Usually the township votes on two miles and oftentimes on more. Probably it would not be so far wrong to give an average of four to five miles; on the lower basis this would add a little over 400 miles, which with the 300 miles furnished by the State would add some 700 miles to the macadam and gravel road miles of the State during the past five years.

TABLE NO. I.

Road and Bridge Tax as Reported to State Auditor by County Clerks.

Counties.	1905	1906.	1907.	1908.	1909.
Adams	$ 40,713	$ 39,523	$ 47,502	$ 44,556	$ 50,906
Alexander	12,484	12,719	15,489	15,302	15,530
Bond	19,996	21,908	31,868	22,373	31,612
Boone	31,148	33,759	34,631	28,225	31,601
Brown	10,667	11,585	12,286	11,049	14,882
Bureau	94,570	80,027	82,991	92,736	106,992
Calhoun	4,541	4,662	5,271	5,429	5,497
Carroll	25,408	27,692	32,526	36,472	37,422
Cass	13,977	15,058	16,356	16,710	19,786
Champaign	90,238	90,185	86,301	103,980	116,233
Christian	43,036	45,722	55,036	60,873	77,546
Clark	27,009	28,724	40,886	28,896	28,367
Clay	11,666	9,709	12,100	13,655	15,252
Clinton	16,269	21,096	25,717	25,748	29,117
Coles	36,731	44,484	43,864	42,837	45,555
Cook	236,984	246,178	267,755	235,879	318,790
Crawford	12,859	14,474	26,703	26,124	34,084
Cumberland	13,975	14,596	15,458	16,024	25,074
DeKalb	71,489	82,100	81,791	86,725	89,098
DeWitt	32,735	34,267	40,994	38,290	44,962
Douglas	30,745	31,435	32,626	35,776	46,278
DuPage	54,988	54,337	59,697	62,152	66,858
Edgar	87,098	87,640	58,077	65,423	67,537
Edwards	5,514	5,653	6,803	6,857	6,862
Effingham	12,957	12,500	26,065	22,455	23,364
Fayette	29,235	34,007	48,645	40,419	42,559
Ford	35,996	39,213	40,872	40,127	54,900
Franklin	10,264	14,729	15,782	20,234	17,411
Fulton	51,524	53,850	69,473	61,975	65,799
Gallatin	9,485	11,353	12,417	13,276	18,473
Greene	28,862	29,763	32,588	36,302	35,381
Grundy	39,748	48,681	53,278	52,362	68,363
Hamilton	11,315	12,565	14,145	14,014	16,668
Hancock	52,685	51,880	54,354	63,007	64,726
Hardin	1,778	1,896	2,039	2,064	2,113
Henderson	15,891	14,913	21,064	22,790	29,523
Henry	67,430	74,127	74,798	79,789	95,488
Iroquois	80,875	71,455	91,208	101,048	91,086
Jackson	20,528	27,455	28,680	22,170	29,647
Jasper	11,158	12,394	15,524	21,701	17,953
Jefferson	13,995	17,111	21,221	27,243	24,045
Jersey	15,069	15,210	15,830	16,121	17,881
Jo Daviess	31,497	33,242	34,036	39,908	36,725
Johnson	5,331	5,276	6,766	6,823	6,827
Kane	110,446	103,001	124,188	110,187	165,419

Table No. I—Concluded.

Counties.	1905.	1906.	1907.	1908.	1909.
Kankakee	$ 57,253	$ 66,868	$ 69,444	$ 58,781	$ 75,497
Kendall	29,357	25,663	36,362	27,571	38,340
Knox	47,824	49,626	51,657	54,404	53,086
Lake	57,298	65,205	66,133	73,484	84,926
LaSalle	141,660	160,443	179,368	184,259	182,098
Lawrence	14,425	16,248	19,001	27,620	28,753
Lee	57,433	53,295	64,055	69,168	67,999
Livingston	72,539	73,443	71,119	78,624	88,085
Logan	66,573	71,504	76,875	75,127	81,708
Macon	64,787	64,043	71,901	75,286	96,846
Macoupin	54,417	60,483	64,990	66,668	55,307
Madison	65,283	74,738	81,217	80,885	95,696
Marion	18,754	21,539	23,155	22,238	36,198
Marshall	32,417	30,374	31,833	31,653	37,253
Mason	25,304	24,098	28,425	27,931	32,065
Massac	4,620	4,831	5,196	5,406	6,141
McDonough	36,741	35,565	39,889	40,076	43,161
McHenry	72,658	71,724	78,942	79,450	70,591
McLean	108,493	112,294	109,341	120,888	163,110
Menard	15,667	14,979	16,298	17,942	18,853
Mercer	44,033	47,141	46,676	45,778	52,757
Monroe	9,411	9,751	10,382	11,551	12,837
Montgomery	36,923	40,452	49,844	50,233	60,752
Morgan	26,264	26,438	34,642	36,610	35,877
Moultrie	28,249	28,095	20,276	24,000	25,132
Ogle	63,846	71,740	82,093	77,750	79,248
Peoria	169,149	122,439	126,946	62,893	56,667
Perry	7,965	8,602	9,521	11,157	11,647
Piatt	30,129	32,775	29,240	34,633	38,138
Pike	28,589	33,084	33,154	35,000	39,850
Pope	4,113	1,406	6,149	4,429	2,731
Pulaski	4,270	4,268	6,963	6,729	6,599
Putnam	9,563	10,121	10,437	9,769	10,178
Randolph	13,845	14,360	14,849	14,825	17,901
Richland	9,156	12,675	13,729	16,109	15,813
Rock Island	29,568	33,328	36,800	37,955	37,731
Saline	16,443	21,524	27,545	29,149	34,125
Sangamon	68,059	70,072	80,476	86,620	98,754
Schuyler	19,434	20,551	22,515	23,850	27,926
Scott	8,983	8,616	9,726	10,149	9,372
Shelby	53,389	43,718	55,190	51,260	48,839
Stark	24,387	25,752	27,223	26,767	27,594
St. Clair	67,904	69,830	66,563	69,383	67,056
Stephenson	40,465	45,634	47,000	46,209	35,743
Tazewell	51,597	49,521	60,100	48,969	59,514
Union	7,097	11,018	11,785	8,264	8,296
Vermilion	123,677	112,520	141,259	169,655	189,868
Wabash	6,889	7,588	8,531	8,531	11,866
Warren	39,125	40,376	45,382	135,457	66,491
Washington	17,266	20,805	22,827	22,777	26,512
Wayne	16,119	16,297	23,871	24,508	26,164
White	18,338	15,489	17,260	17,609	13,901
Whiteside	52,235	58,647	66,990	75,132	64,651
Will	110,513	109,246	119,458	113,975	118,390
Williamson	8,702	9,070	14,434	25,584	26,987
Winnebago	76,066	81,069	92,213	99,881	105,826
Woodford	33,228	32,657	35,271	38,620	44,595
Total	$4,099,401	$4,205,792	$4,648,222	$4,765,337	$5,222,234

TABLE NO. II.

Hard Road Tax Voted During the Years 1905-1909, Inclusive.

Adams	$ 4,437	Lee	$38,719
Alexander	.....	Livingston	4,788
Bond	39,000	Logan	.....
Boone	45,627	Macon	.....
Brown	.....	Macoupin	.....
Bureau	.....	Madison	70,000
Calhoun	.....	Marion	.....
Carroll	.....	Marshall	.....
Cass	.....	Mason	.....
Champaign	.....	Massac	.....
Christian	.....	McDonough	.....
Clark	81,875	McHenry	.....
Clay	6,471	McLean	.....
Clinton	.....	Menard	.....
Coles	66,500	Mercer	.....
Cook	58,961	Monroe	.....
Crawford	127,397	Montgomery	21,000
Cumberland	.....	Morgan	.....
DeKalb	17,192	Moultrie	.....
DeWitt	.....	Ogle	34,400
Douglas	36,608	Peoria	.....
DuPage	63,414	Perry	.....
Edgar	147,842	Piatt	.....
Edwards	.....	Pike	6,303
Effingham	7,500	Pope	.....
Fayette	.....	Pulaski	10,271
Ford	.....	Putnam	.....
Franklin	.....	Randolph	.....
Fulton	35,000	Richland	.....
Gallatin	64,370	Rock Island	900
Greene	.....	Saline	22,076
Grundy	50,500	Sangamon	.....
Hamilton	.....	Schuyler	.....
Hancock	.....	Scott	.....
Hardin	.....	Shelby	.....
Henderson	.....	Stark	.....
Henry	.....	St. Clair	2,771
Iroquois	35,000	Stephenson	.....
Jackson	10,953	Tazewell	.....
Jasper	.....	Union	.....
Jefferson	.....	Vermilion	27,374
Jersey	14,000	Wabash	17,000
JoDaviess	.....	Warren	24,546
Johnson	.....	Washington	1,172
Kane	.....	Wayne	.....
Kankakee	70,570	White	32,500
Kendall	40,183	Whiteside	10,353
Knox	.....	Will	41,689
Lake	47,237	Williamson	.....
LaSalle	93,083	Winnebago	4,000
Lawrence	.....	Woodford	.....
		Total	$1,533,582

PUBLIC MEETINGS ATTENDED.

During the years 1908 and 1909 many public meetings were attended by representatives of the Commission at the request of the various bodies under whose auspices the meetings were held. In this regard, as in its other work, the Commission has consistently pursued the policy of not offering advice or allowing its representatives to be placed on a program unless an invitation to do so has been first tendered to the Commission. Had any other policy been adopted, there might have been some grounds for the fears expressed by some that the State proposed to force upon them expensive and impracticable methods of road construction. However, no embarrassment has developed from a lack of invitations as shown by the fact that they have come from all parts of the State and from associations of practically every character which could be supposed to have an interest in highway matters.

Except in one or two instances, when a number of farmers' institutes were in session the same day, has it been necessary to refuse a request for a speaker. During 1908 and 1909 all requests to attend farmers' institutes have been filled and practically all other invitations accepted. As in 1906 and 1907, by far the larger number of meetings attended were the farmers' institutes, and they constitute beyond question the most important series of public gatherings to which speakers have been sent by the Commission.

At these gatherings the greatest interest centers in township road work, and the aim has been to suggest such practical methods of administration and of construction as may be readily put in operation. In many cases a special topic was suggested, such as "The Construction of Earth Roads and Bridges," "Methods of Township Road Management," "Construction of Macadam and Gravel Roads," according to the interest in the locality where the meeting was held. In every instance the opportunities afforded by the Commission to the township officials were carefully explained, yet, with all the publicity it has been possible to give to the work of the Commission, through the press, by various bulletins, and the large number of meetings attended, there is still in nearly every audience only a small minority who know about the Commission and its work. The majority of the people are surprised to learn that the State will, upon the request of the local road officials, send a practical engineer to advise with them as to how a certain piece of road should be constructed, make estimates of the cost, take general

charge of the construction if so requested, and, as far as possible, furnish the machinery and crushed stone if a piece of macadam work is to be laid, and furnish plans, estimates, and supervision for bridge construction, all of which is done without cost to the local commissioners.

Therefore, although it is telling the same story over many times, it is still felt to be a most important feature at all these meetings to explain carefully what the State Highway Commission is doing, so that as many taxpayers as possible may know about the work and be interested in having their locality secure its portion of assistance and help.

The total number of meetings attended in 1906 was 48; in 1907, 111; in 1908, 117; in 1909, 111. The following tables show the dates, localities and associations under whose auspices the various meetings were held in 1908 and 1909. Similar tables for 1906 and 1907 will be found in the reports for these years.

TABLE No. III.

Meetings Attended 1908.

Date.	County.	Town.	Association.
Jan. 1	Vermilion	Danville	Farmers Institute
7	Cook	Chicago	Western Society Civil Engineers & Surveyors
8	Lake	Gurnee	Farmers Institute
8	Edgar	Paris	..do
9	McHenry	Richmond	..do
9	Henry	Woodhull	..do
9	Clark	Marshall	..do
10	Rock Island	Taylor Ridge	..do
10	Piatt	Cerro Gordo	..do
11	Grundy	Mazon	..do
14	Carroll	Lanark	..do
14	Winnebago	Durand	..do
15	Champaign	Champaign	Illinois Society of Engineers & Surveyors
15	Henry	Galva	Farmers Institute
15	Stephenson	Freeport	..do
15	Iroquois	Watseka	..do
16	JoDaviess	Apple River	..do
16	Kankakee	Kankakee	..do
16	Boone	Belvidere	..do
16	Champaign	Champaign	Illinois Society of Engineers & Surveyors
17	..do	..do	..do
17	Moultrie	Sullivan	Farmers Institute
17	Kane	Elgin	..do
17	Douglas	Hindsboro	..do
17	Livingston	Pontiac	..do
18	DeWitt	Farmer City	..do
22	Macon	Harristown	Citizen's Meeting
25	Randolph	Evansville	Randolph County Road Commissioners' Association
28	DuPage	Wheaton	Farmers Institute
Feb. 8	Moultrie	Bethany	..do
11	Cook	Chicago	Illinois Lumbermen's Association
12	..do	..do	..do
13	Peoria	Peoria	State Farmers Institute
21	Brown	Timewell	Farmers Institute
22	Fayette	Vandalia	Rural Letter Carriers' Association
24	JoDaviess	Warren	Citizens' Meeting
25	..do	Galena	..do
26	..do	Eliazbeth	..do
27	..do	Stockton	..do
28	Stephenson	Lena	..do
Mar. 5	Christian	Taylorville	Association Supervisors & Highway Commissioners
21	Tazewell	Delavan	Citizens' Meeting
28	Greene	Carrollton	..do
28	JoDaviess	Hanover	..do
31	Mercer	Aledo	Commercial Association
pr. 1	Kane	Batavia	Council and Chamber of Commerce
3	Rock Island	Rock Island	Rock Island Booster Club
17	Kankakee	Kankakee	Kankakee Motor Club

Table No. III—Concluded.

Date.	County.	Town.	Association.
May 16	Cumberland	Neoga	Citizens' Meeting
July 7	Buffalo	New York	State Commissioners' Road Convention
18	Montgomery	Litchfield	Citizens' Meeting
22	Grand Rapids	Michigan	Road Convention
25	Clinton	Trenton	Citizens' Meeting
Sept. 1	Henry	Kewanee	do
17	Marion	Salem	Farmers Institute
23	Tazewell	Morton	do
24	do	Tazewell	do
Oct. 6	Coles	Humbolt	do
6	McDonough	Adair	do
7	Fulton	Astoria	do
9	DuPage	Naperville	Citizens' Meeting
9	Schuyler	Rushville	Farmers' Institute
13	Brown	Timewell	do
14	do	Mt. Sterling	do
14	Kankakee	Kankakee	State Convention Supervisors and Town Clerks
14	Mason	Manito	Farmers Institute
14	Bond	Greenville	do
15	Christian	Stonington	do
15	Edwards	Browns	do
15	Madison	Edwardsville	do
15	Brown	Versailles	do
16	Monroe	Waterloo	do
20	Menard	Petersburg	do
21	Cook	Chicago	Western Society of Civil Engineers
21	Morgan	Jacksonville	Farmers Institute
21	Union	Anna	do
21	Saline	Raleigh	do
22	Cass	Virginia	do
22	Shelby	Findlay	do
22	Pulaski	Grand Chain	do
23	Alexander	Thebes	do
23	Cumberland	Toledo	do
27	Williamson	Marion	do
27	Wayne	Cisne	do
28	White	Carmi	do
28	Franklin	Benton	do
28	Montgomery	Witt	do
30	Hamilton	McLeansboro	do
Nov. 10	Randolph	Red Bud	do
10	Clinton	Carlyle	do
11	St. Clair	Belleville	do
11	Perry	Cutler	do
11	Jefferson	Mt. Vernon	do
12	Sangamon	Springfield	do
12	Fayette	Vandalia	do
12	Randolph	Coulterville	do
12	Washington	Nashville	do
13	Macoupin	Bunker Hill	do
14	Randolph	Sparta	do
Dec. 3	Jasper	Newton	do
4	Crawford	Robinson	do
8	Whiteside	Morrison	do
9	DeWitt	Clinton	do
9	Lee	Harmon	do
10	Hancock	Carthage	do
10	McLean	Bloomington	do
15	Rock Island	Port Byron	do
15	Putnam	Hennepin	do
16	Greene	Whitehall	do
16	Marshall	Henry	do
16	McHenry	Marengo	do
16	Mercer	Viola	do
16	Stark	Toulon	do
17	Bureau	Neponset	do
17	Henderson	Raritan	do
17	Henry	Osco	do
23	Ford	Gibson City	do

TABLE No. IV.

Meetings Attended 1909.

Date.	County.	Town.	Association.
Jan. 2	Sangamon	Springfield	Highway Commission and Chamber of Commerce
5	Woodford	Metamora	County Farmers Institute
6	..do	Roanoke	..do
6	McLean	LeRoy	..do
7	Columbia, Mo.		County Highway Engineers of Missouri
7	Boone	Caledonia	County Farmers Institute
8	..do	Capron	..do
8	Kane	Geneva	..do
9	Woodford	Eureka	..do
9	McHenry	Harvard	..do
13	Piatt	Monticello	..do
13	Boone	Belvidere	..do
14	Iroquois	Watseka	..do
14	Kankakee	Kankakee	..do
14	Will	Joliet	..do
15	DuPage	Wheaton	..do
15	Clark	Marshall	..do
16	Douglas	Hindsboro	..do
21	Jersey	Jerseyville	Jersey County Good Roads League
22-3	Saline	Harrisburg	Good Roads Meeting
27-8	Cook	Chicago	Illinois Society Engineers & Surveyors
27	Bureau	Ohio	Ohio Good Roads Meeting
29	Livingston	Fairbury	County Farmers Institute
Feb. 3	LaSalle	Ottawa	..do
4	Kendall	Yorkville	..do
5	Moultrie	Sullivan	..do
24-5	Winnebago	Rockford	State Farmers Institute
Mar. 6	Stephenson	Freeport	Association Highway Commissioners Stephenson County.
13	Adams	Quincy	Citizens' and Commissioners' Meeting
16	Whiteside	Tampico	Good Roads Meeting
17	..do	Morrison	Morrison Commercial Club
20	Douglas	Hindsboro	Citizens' Meeting
Apr. 2	Brown	Mt. Sterling	Business Men's Good Roads Meeting
3	Lawrence	Lawrenceville	Citizens' Meeting
3	Brown	Mt. Sterling	Commissioners' Good Roads Meeting
9	Adams	Plainville	Good Roads Meeting
10	Sangamon	Springfield	Highway Commissioners' Association
16	Pike	Pittsfield	Good Roads Meeting
17	Union	Anna	..do
May 14	Schuyler	Rushville	..do
17	Madison	Alton	Business Men's Association
June 23	St. Clair	E. St. Louis	Rock Products Social Club
July 2	St. Paul, Minn.		State Engineers' Meeting
5-7	Seattle, Wash.		Road Congress
Aug. 6	Macoupin	Brighton	Citizens' Meeting (Betsey Ann Day)
28	LaSalle	Glen Park	Citizens' Meeting
Sept. 4	Adams	Quincy	Adams County Commissioners' Association
Oct. 1	Peoria	Glasford	County Farmers Institute
13	Monroe	Waterloo	..do
14	Schuyler	Rushville	..do
14	Bond	Greenville	..do
15	Madison	Granite City	..do
15	Marshall	Lacon	..do
19	Coles	Oakland	..do
19	Sangamon	Auburn	..do
20	Jackson	Ava	..do
20	Coles	Doran	..do
21	..do	Lerna	..do
21	White	Carmi	..do
22	Cass	Virginia	..do
22	Jackson	Carbondale	..do
22	Hamilton	McLeansboro	..do
26-8	Columbus, O.		Road Convention
28	Shelby	Oconee	County Farmers Institute
29	Cumberland	Toledo	..do

Table No. IV—Concluded.

Date.	County.	Town.	Association.
Nov. 3	Cook	Chicago	Western Society Engineers & Surveyors
3	Jefferson	Mt. Vernon	County Farmers Institute
3	St. Clair	New Athens	..do
4	Clinton	Bartelso	..do
4	Washington	Nashville	..do
5	Fayette	Vandalia	..do
10	Wabash	Mt. Carmel	..do
10	Perry	Tamarpa	..do
11	Randolph	Sparta	..do
12	Perry	Pinckneyville	..do
13	Randolph	Coulterville	..do
17	Richland	Olney	..do
18	Marion	Salem	..do
19	..do	Noble	..do
19	Logan	Mt. Pulaski	..do
30	Pike	Barry	..do
Dec. 1	..do	Pittsfield	..do
4	Fayette	Vandalia	Highway Commissioners Association
8	Jersey	Jerseyville	County Farmers Institute
8	Mercer	Aledo	..do
9	Lake	Libertyville	..do
8	Lee	Harmon	..do
9	Ogle	Holcomb	..do
9	Brown	Mt. Sterling	..do
9	Henderson	Biggsville	..do
9	Greene	Roodhouse	..do
10	Henderson	Raritan	..do
10	Cook	Niles Center	..do
11	DeWitt	Farmer City	..do
14	Effingham	Effingham	Citizens Meeting
14	..do	..do	County Farmers Institute
14	Ford	Elliott	..do
14	Logan	Lincoln	..do
14	Henry	Woodhull	..do
15	..do	Orion	..do
15	McLean	Bloomington	..do
15	Stark	Wyoming	..do
15	Crawford	Palestine	..do
16	Jasper	Newton	..do
16	Champaign	Fisher	..do
16	Ford	Roberts	..do
16	Knox	Oneida	..do
17	Warren	Monmouth	..do
17	Crawford	Oblong	Good Roads Meeting
18	Stephenson	Freeport	Association Highway Commissioners Stephenson County.
18	McDonough	Macomb	County Farmers Institute

EARTH ROADS.

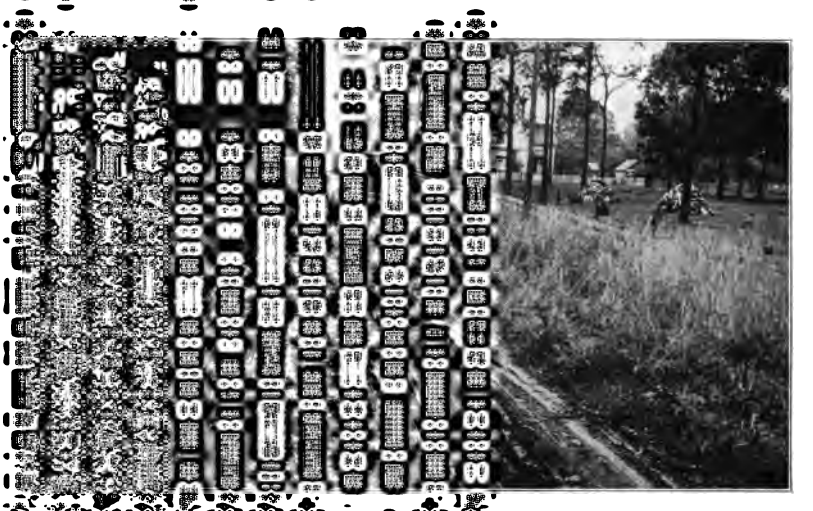
Earth roads are a matter of paramount importance in the maintenance of the public road system of Illinois. Their vast mileage and their preponderance over all other kinds of roads and the absolute necessity of using them should make their improvement a matter of serious study and earnest effort.

The principles which underlie the proper construction and maintenance of earth roads are well known. The beneficial results have been demonstrated and the cost is no longer a matter for conjecture. As has been shown, the annual cost for the maintenance of our public roads and bridges in this State is upwards of six millions of dollars. Not less than half this sum is spent on our earth roads, an annual expenditure quite sufficient to maintain these roads in the highest state of efficiency. Such a result can be obtained if the money is spent intelligently and efficiently.

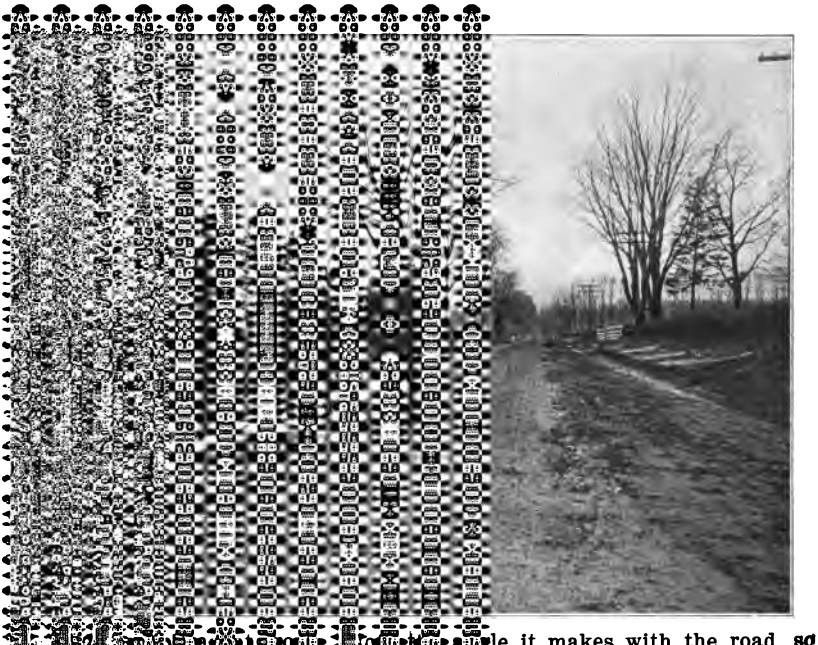
Better Earth Roads Are Possible.

Before dwelling on the methods to be followed, it is perhaps important to consider what could be expected if our earth roads were maintained in the proper manner. Eventually the knolls would be cut down; intervening hollows raised; roads across bottoms and lowlands built on embankments; all seepy places underdrained; gradual oval rise in the center of the road and equally gradual shapes to the gutters. Vehicles should not expect to overturn if it became necessary to drive in the gutter. Weeds should not grow on the roadside; rather, a good sod to serve as a protection to the gutter and to add to the neat appearance of the road. A row of weeds and grass would not occupy the center of the road and force travel to one side; nor mud holes and deep ruts be found in the summer time nor an uneven surface at any time. The foregoing requisites may be considered our specifications.

The question of chief interest is, can such results be obtained under our present road system? and the answer is, these results can be obtained because they have been obtained. Wherever the township highway commissioners have set out intelligently and earnestly to get these results, they have been practically accomplished, and not this alone, but accomplished with the money that is raised from the ordinary road and bridge taxes.



[illegible] found during September. Shows [illegible] loads of earth to raise the road [illegible] summer time, at least.



[illegible] Earth roads should be [illegible] angle it makes with the road, so [illegible] material to the center of the road.

The work of the Good Roads Association at Galva shows what could be done with a very ordinary expenditure. The work of the commissioners in Bement township and about Arcola and Tuscola has illustrated the great improvement that intelligent work done at the right time can accomplish in the condition of our earth roads; improvement hardly believed possible, even a few years ago, when the principles and the methods of caring for our earth roads were not so well understood or widely known.

Principles of Construction.

What are these principles is the next point of interest. If it is constantly borne in mind that a dry subgrade is the essential in maintaining a good road surface, the uselessness of much work that is done today will become apparent. To secure a dry foundation, means first that the surface water must be kept out or that we must have water-tight roof to our road; second, the underground water, where such exists, must not be allowed to percolate underneath the road, making what are known as seepy places. If water-tight roof is made and given the proper shape to throw the water away from the center of the road, it is then necessary to take care of this water and conduct it in properly formed gutters quickly as possible to some outlet where the accumulating volume of water will not do further damage to the gutter or the road. In other words, practically everything done to improve the road is really to effect the drainage of the road by stopping leaks in the roof, giving the roof a proper shape, building proper gutters, and, when necessary, tile draining the foundations. Every move is an endeavor to keep the water away and out of the road.

It will be contended if the roof of our road is built of earth, it is not waterproof, and this is true, but it should be made as nearly waterproof as possible. It should be plain that a mass of weeds and loose dirt in the center of the road only make an absorbent roof rather than one which will turn water, and yet how many thousands of miles of road and millions of dollars have been spent on such work. When this is done early in the spring so that traffic will have an opportunity to compact this loose material, the effects are not so disastrous as when the work is done later in the season, as is more often the case, in which event the fall and winter rain thoroughly penetrates the whole surface of the road, with the result that in the spring the road cuts deeper than if it had been let alone with the old hard surface undisturbed.

A road on a steep hill is bad no matter what the condition of surface may be. It is a useless waste of energy to pull loads up and down small hills; to tug up one hill only to hold back to prevent going too fast down the next. If roads have steep grades or hills, these should be eliminated as far as practicable. To grade a hill properly, it is necessary that a survey be made so that one will know just how deep it is necessary to dig to reach the required slope. If done by guess or by eye, without such guiding marks, an acceptable grade is never built except at the expense of moving material more than once, finding that too much has been put in one place and must be cut out and removed

to another, thus by this cut and try method, get the results that could be obtained with the aid of a survey in the first instance without useless work.

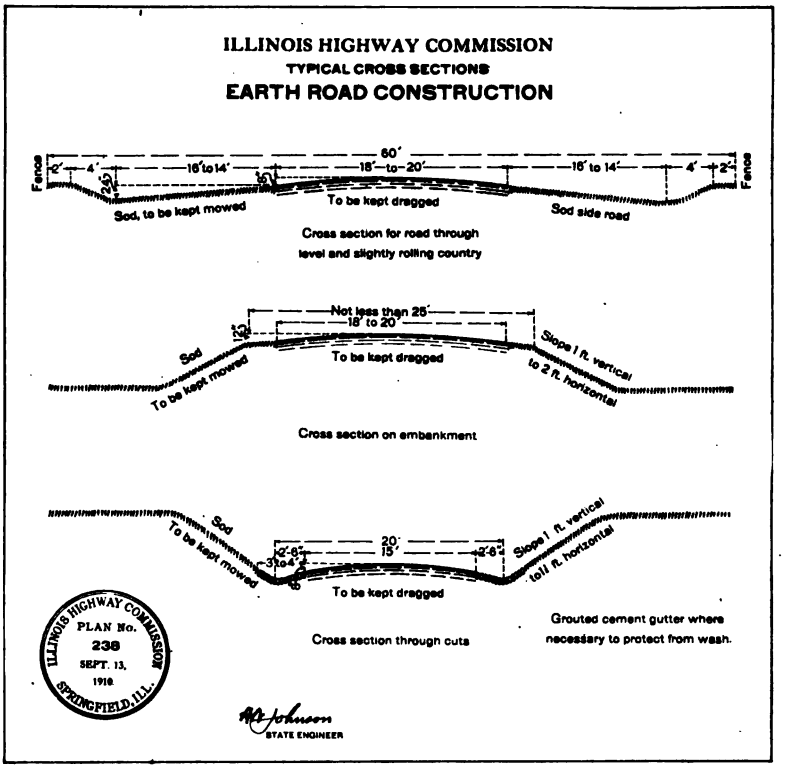
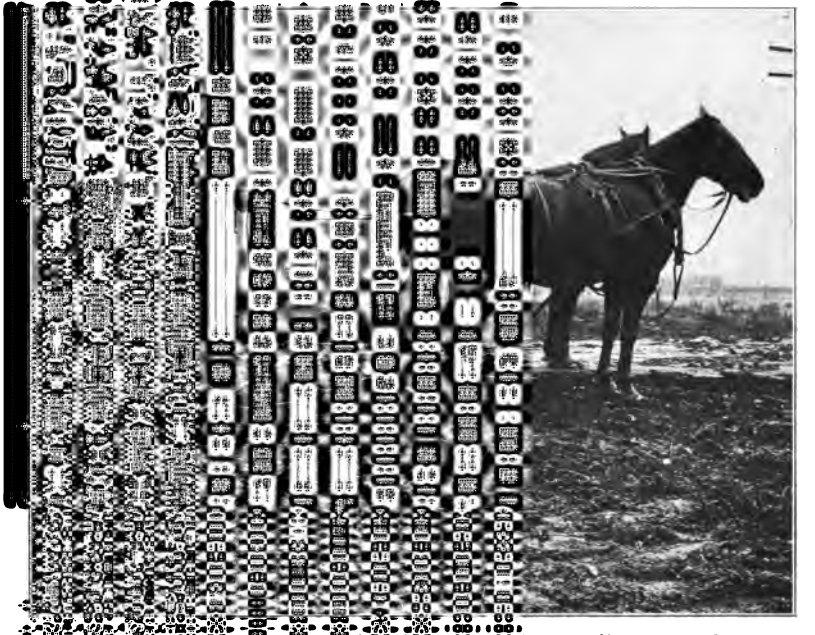


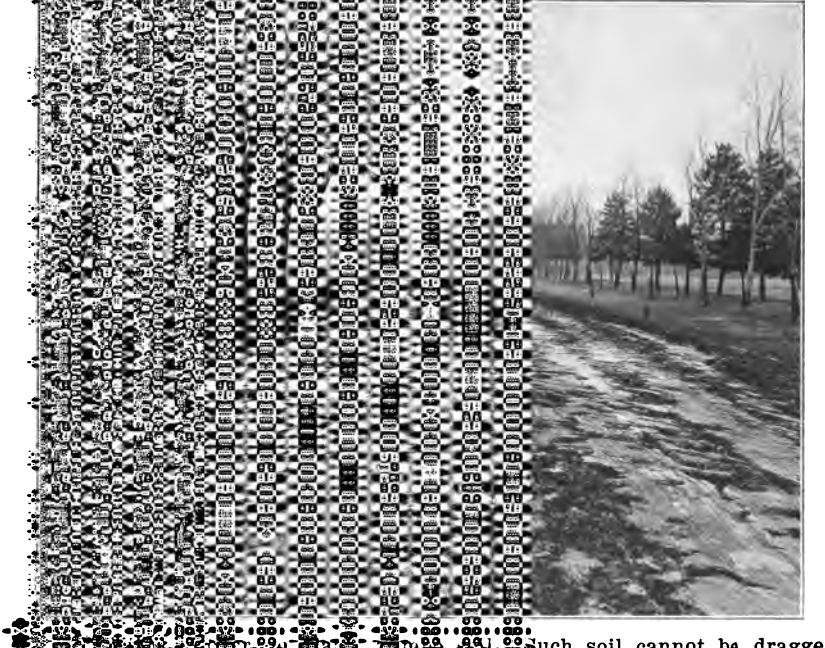
Figure 1.

Earth roads must have a proper shape. The accompanying diagram shows more clearly than explanation can do what the shape should be. On ordinary slightly rolling or level country, the aim is to raise the traveled parts of the road above the surrounding land as much as possible without creating unsightly and dangerously deep ditches at the sides. Where roads are built across low places and embankments are required, they should not be less than 25 feet in width at the top with a gradual side slope not steeper than one vertical to every two feet horizontal. This shall enable the sod to grow readily and protect the slope from further wash. Through deep cuts, the roadway may be narrowed to lessen the cost of construction. On long steep hills, if the gutters are to be maintained, it will be absolutely necessary to pave them either with cobbles or with concrete.

Leaving out of consideration those sections of roads on which it is necessary to make heavy cuts and fills or to construct embankments, all



[illegible] sticky soils. Here the drag is [illegible] the edge of the plank acts as [illegible]



[illegible] such soil cannot be dragged [illegible] or stick to the drag.

of which should be first laid out by the engineer, we have the majority of the earth road conditions where there is to be a great amount of filling or cutting, where it is necessary merely to shape the roads, using the material immediately alongside. In such situations, where the road is flat, or, as is oftentimes the case, somewhat lower in the center than at the sides, it becomes necessary to raise the center portion of the road by moving the material at the sides to the center. This is most readily done with a road machine, but should not be done except in the early portion of the year, as early in the spring as it is possible to work a grader. In this way, the summer travel will compact the loose material and get it into condition to withstand the fall and winter rains.

After a road is properly graded and shaped, the maintenance of the road surface is to be considered.

Best Methods Require a Little Work Done Often.

To maintain an earth road in good condition requires constant attention. The work cannot all be done at one time. It is necessary that a little be done often; and it is here where failure has occurred in the past.

No longer than four or five years ago it was the custom, not alone in Illinois, where the roads were worked at all, to shape them with a grader possibly once a year and neglect them the remainder of the year, save possible cutting the weeds alongside. But in the past four or five years, it has been demonstrated on thousands of miles of road that the surface of earth roads can be vastly improved if a little work is done often; not to attempt very much at any one time, but merely to smooth over the surface, covering up what small ruts there may be at the time, and to do this work when the surface of the road is moist or wet as the soil will permit the work to be done. For this purpose, the now familiar road drag is used.

Great interest in this method of maintaining earth roads has been shown. Road machinery companies are putting out smaller machines; many are selling steel road drags, all with the one object in view that a small amount of work is to be done often. It frequently happens, however, that the work can best be done with a very inexpensive implement, and, as a rule, on most soils it is not necessary to use an expensive heavy steel drag. The work can be done better with the lighter wooden drag.

The Illinois Highway Commission has distributed many thousands of bulletins (Nos. 1 and 2) on road dragging, how to make the drag and how to use it, to which reference should be made for more detailed information than it is perhaps necessary to give here. This method of maintaining roads was discussed at many hundreds of farmers' institutes, with the result that there was great enthusiasm displayed at first and very many drags used and made during 1906 and the spring of 1907. In 1908 there was an evident falling off in their use, which seemed to be reviving in 1909, with every evidence that during 1910 there were as many in use, and probably more miles systematically maintained, than ever before.

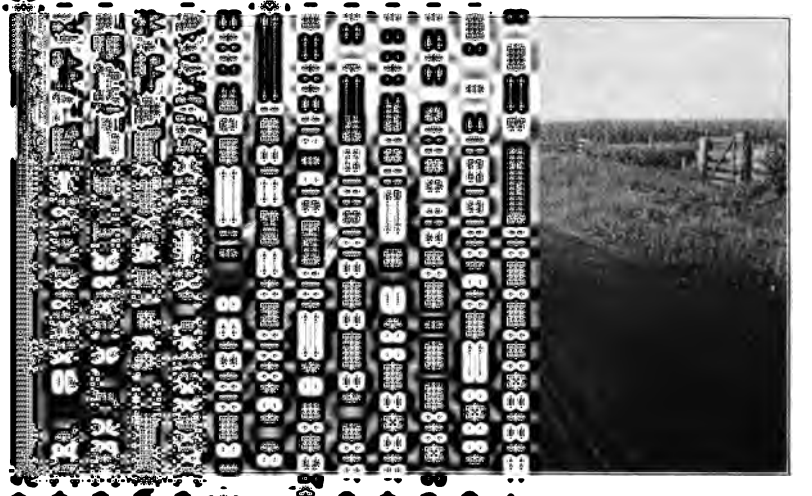
There is a very ready explanation for this phenomenon. Many enthusiasts, in talking about the road drag and describing it and its results, had rather overestimated what these results should be, and led many to suppose that even an occasional dragging of the road would produce most wonderful effects. Then, too, there was the enthusiasm of newly aroused interest, so that with the disappointment of some, and the natural abatement of interest in others, there was less work of this character done than in the beginning. Its revival has been brought about in part through the automobile interests. Automobiles are owned practically everywhere and are used everywhere on the roads, and a smooth earth road furnishes one of the most enjoyable road surfaces for either automobile or horse drawn traffic. The effect has been, whatever the cause, to carry on in many sections more systematically this form of road maintenance.

But it is useless to expect the public roads to be cared for thoroughly and energetically if left to the spasmodic attention of neighboring residents. If the roads are to be maintained properly, some one must be paid a reasonable amount for the work that is done; it must be somebody's business to see that this work is done at the proper time, and only where this plan has been put in effect have the results been satisfactory.

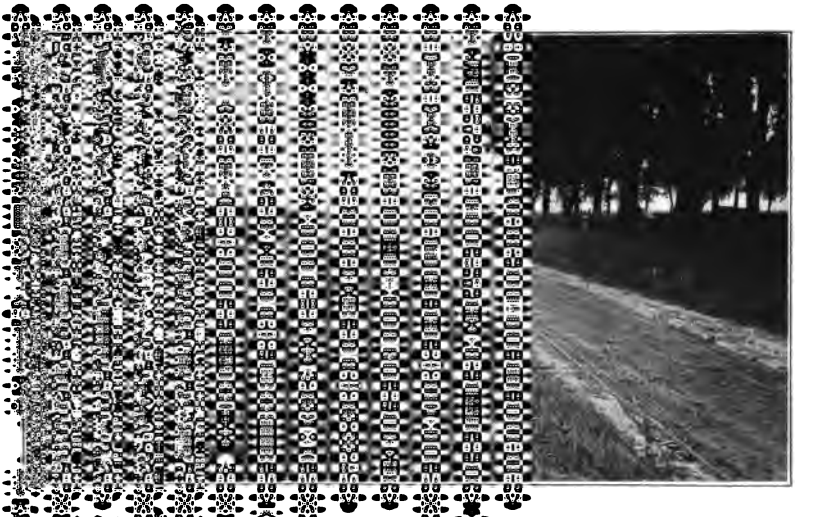
Drag the Roads at All Seasons.

The most important thing about road dragging is to drag the road; there are many matters of detail, but the essential thing is to have the work done, and to have it done throughout the year when it should be done.

The result of road dragging in many sections of the State has been very carefully observed, and conflicting opinions are held as to how and when a road should be dragged. Some will maintain that immediately after a rain, when the road is very wet, is the best time to do the work; others will argue equally strongly that it cannot be done at that time, but must be delayed until the road partially dries out so that the soil will drag more easily; some will say they get the best results with a leaning drag; others find a drag of somewhat different make works better; all of which illustrates the point that the same kind of a drag and the same method of doing the work is not best adapted for all soil conditions. In general, it may be stated that black, heavy, sticky soils cannot be dragged successfully during or immediately following a heavy rain; that the time to work these roads seems to be when they just pass the state of "rolling up," and usually a leaning or smoothing drag will work somewhat better than the drag which has more or less of a cutting edge. On the lighter clay soils, which do not work up so sticky and absorb water more readily than the heavy black soils, the work can usually be done best immediately following a rain, and a plank or straight edge drag will work to the best advantage, although there are times when a smoothing drag is about all that is required.



[illegible] at center. Note that the [illegible] below.



[illegible] and two lines of traffic [illegible] loose material in center of

It has been noticed on many roads that have been dragged there is a tendency to leave a ridge of loose material in the center of the road, which is always avoided by traffic, so that in a very short time two lines of traffic will form with grass and weeds growing in the center of the road. This would be obviated should a third round be made and the drag set cross-wise so as to smooth out the center of the road, making it the most attractive portion. In this way, the traffic will be thrown to the center, which it will pack down and keep in better shape. This will tend to maintain a uniform crown to the road and allow the gutters, side roads and shoulders to grow a sod, which can be used when the roads become most cut up.

It should not be expected that the maintenance of earth roads by a drag will prevent mud; the most that can be accomplished is to have less mud. It should be noticed that the object of road dragging and what it accomplishes and why it accomplishes it, is merely because it tends to make the surface waterproof by smoothing over the surface of the clay or gumbo road when it is wet, which tends to puddle it and drying out smooth leaves a crust of partially waterproof earth. As this work is continued, this waterproof layer becomes thicker and more consolidated and thus offers more and more protection to the foundation of the road from the next rain; thus it is that such roads do not cut or become water soaked, and the frost does not penetrate them so deeply. Whatever is done to the surface of an earth road, it must be kept in mind it is an endeavor to make it waterproof, and if anything is done to disturb this condition it will prove in the end harmful.

To conclude, attention should be fixed on one or two essential points. Earth roads can be improved; can be improved at a cost within present expenditures; that the usual method in vogue today will not accomplish the results; but in every township there should be some one whose business it is constantly to look after the roads.

In the last analysis, the improvement of the earth roads with the people themselves, for so soon as it becomes the sentiment of a community to regard the office of township highway commissioners, not as a means of livelihood for some more or less energetic politician, but as an honorable public trust, worthy the attention of the best citizen, and further to require that the work be done by some one on the job all the time as the law now permits, winter and summer, then will earth roads show improvement commensurate with the money now spent upon them.

CRUSHED STONE PREPARED AT THE PENITENTIARIES.

CONVICT LABOR ON ROAD MATERIAL, ETC.

AN ACT to amend section 2 of an Act entitled, "An Act authorizing and empowering the employment of convicts and prisoners in the penal and reformatory institutions of the State of Illinois in the manufacture of tile and culvert pipe for road drainage purposes, and in the manufacture of machinery, tools and appliances for the building, maintaining and repairing of the wagon roads of the State, and for preparing road building and ballasting material, upon the requisition of the State Highway Commission," approved May 18, 1905, in force July 1, 1905.

SECTION 1. *Be it enacted by the People of the State of Illinois, represented in the General Assembly:* That section 2 of an Act entitled, "An Act authorizing and empowering the employment of convicts and prisoners in the penal and reformatory institutions of the State of Illinois in the manufacture of tile and culvert pipe for road drainage purposes, and in the manufacture of machinery, tools and appliances for the building, maintaining and repairing of the wagon roads of the State, and for preparing road building and ballasting material, upon the requisition of the State Highway Commission," approved May 5, 1905, in force July 1, 1905, be and the same is hereby amended so as to read as follows:

SEC. 2. The commissioners of highways in any township in counties under township organization or the commissioners of highways or boards of county commissioners in counties not under township organization may make application to the said State Highway Commission for such road building material, tile, culvert pipe, road making machinery, tools and other appliances as may be needed or required by them for the construction, improvement or repairing of the wagon roads in their respective townships or road districts, and where by agreement of the commissioners of highways in counties under township organization, or the commissioners of highways or boards of county commissioners in counties not under township organization, as the case may be, with the city council of any city, or the board of trustees of any village within the limits of such town, any gravel, rock, macadam or other hard road is extended within or through the corporate limits of such city or village then for the construction, improvement or repairing of so much of said road as lies within the corporate limits of such city or village, provided such extension within such city or village shall be of the same cost and kind of material as the road outside such city or village, obligating themselves to use such material according to the rules and regulations formulated and approved by the State Highway Commission.

Approved June 3, 1907.

A well built earth road. Note broad, shallow, sodded gutters. Center maintained with drag.

Revised Law Concerning the Use of Free Macadam.

The law which provides for the distribution of crushed stone, prepared at the penitentiaries, has been amended so that this material may be used inside the corporate limits of villages and cities, provided it is used in extending a road from the township into the corporation, and that the township officials give their consent for the material to be so used.

Distribution of Crushed Stone Prepared at the Penitentiaries.

The results of the preparation and distribution of crushed stone from the State penitentiaries are summarized in the following tables. There are many towns applying in previous years who had received no material, whose applications were still in force, so that the number applying and the amount applied for in a given year does not constitute the measure of the total demanded. At all times the demand has been in excess of the supply. Without doubt if this plan is to be carried to a logical conclusion and give all sections of the State an equal chance, additional quarries should be established. To this end a bill was introduced in the Forty-sixth General Assembly which provided for additional quarry sites. This bill passed the House but failed to pass the Senate. As it is, however, the present quarries have been run without any increase of appropriations, so that they have been to no extra expense to the taxpayers; thus the counties that are receiving the material do not do so at an extra expense to those not so fortunate. As was pointed out in the report for 1907, it is difficult to see how any more equitable plan could be devised.

A study of the following tables will show that applications for crushed stone were received from 41 townships in 26 counties in 1908 and from 65 townships in 34 counties in 1909. The total amount applied for during 1908 was 100,680 cubic yards, and 227,690 cubic yards in 1909. The general distribution is shown in Table No. VI. In 1908, 54 townships in 30 counties received material and 75 townships in 40 counties in 1909.

In Table No. VII, a summary of the shipments of crushed stone for each month during 1908 and 1909 is shown; the total for 1908 being 120,240 cubic yards, and for 1909, 136,789 cubic yards. This amount included in 1908, 3,800 cubic yards delivered to the C. & A. Railroad for ballast and 789 cubic yards used on bridges and repair work not listed in Tables No. VIII and IX. The amounts as here given for 1909 includes 4,169 cubic yards delivered to the C. & A. Railroad for ballast in payment of freight, and 1,892 cubic yards used for bridges and minor repairs.

Material has been supplied under two general plans for coöperation between the Highway Commission and the township commissioners; one where only general supervision was furnished by the State, and the other where machinery and constant superintendence was furnished; the latter being in the case of experimental roads. The tables showing the distri-

bution to the townships for each year have therefore been divided accordingly, as the material was shipped for experimental and non-experimental work.

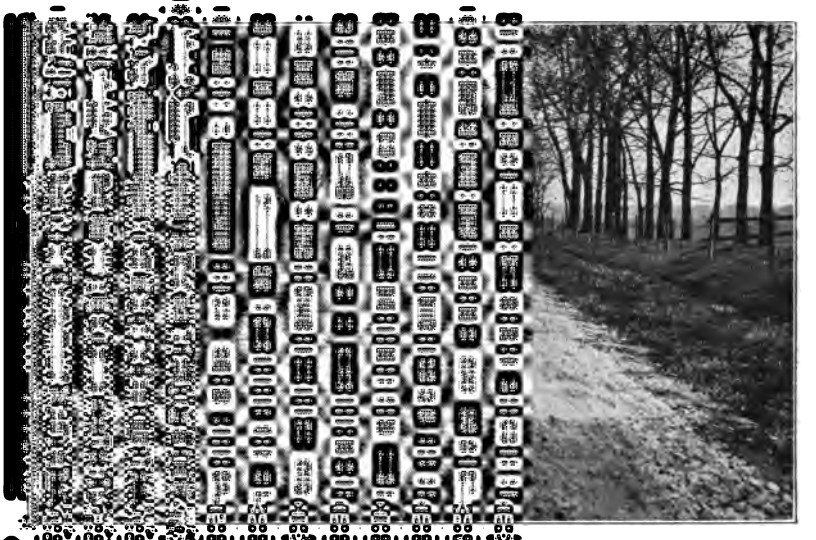
How to Apply for Crushed Stone.

According to the law under which the distribution of crushed stone is made, the township road officials must make application to the State Highway Commission for the amount desired. The application should be made on special blanks prepared for this purpose, which will be sent by the State Highway Commission upon receipt of a request for same. A special bulletin, No. 4, issued by the State Highway Commission, explains in detail how to use the rock to the best advantage.

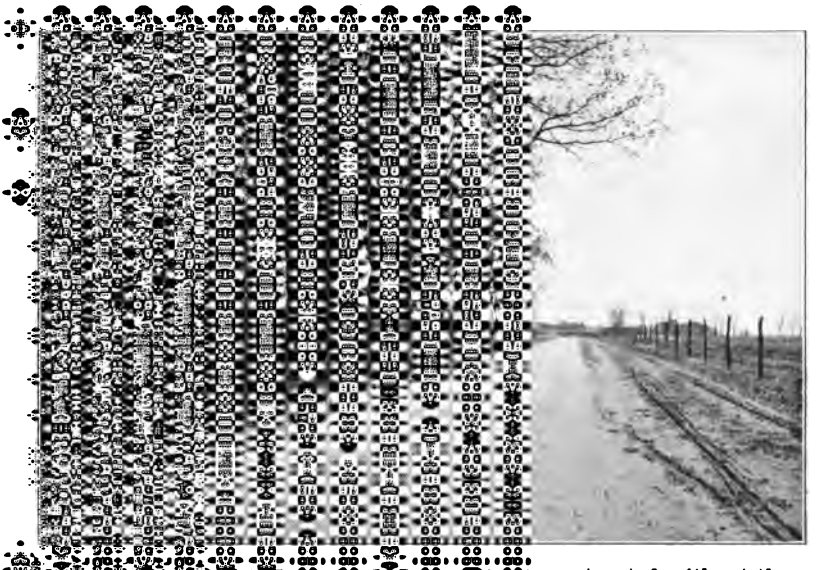
The results that are being obtained prove that with a little care and attention to details, not only can a very serviceable but a very good appearing road be made without the use of expensive machinery. But a road made without the use of the roller, if it is to have an even surface, must have constant attention particularly during the first season. A road made in this manner will develop ruts along the wheel tracks about as soon as opened to traffic; when these are formed, they should be raked in and thereafter, as often as the ruts reappear, should be filled with stone. It will be evident that in time, depending on the amount of traffic, that the portion of the stone layer under the wheel will become thoroughly compacted, and if more material is added to take the place of that which has been pushed together, the ruts will be filled, and, owing to the compactness of the material underneath, will not so readily form again. Other defects commonly noticed are the depressions or pockets that develop; these are usually caused by one of two conditions: either the foundation is soft, through bad drainage, or the material was not evenly spread or mixed, so that nests or clusters of very fine material occur in the surface layer. Such a place will wear faster than the surrounding portion of the road composed of larger sized material, and a depression soon develops.

It is not usually difficult to tell what causes a depression. If it is the result of a bad foundation, the hollows are apt to be of considerable size, often extending entirely across the road, but when caused by unevenly spread materials are usually much smaller. Also, if the depression is caused by a badly drained foundation, there may be immediately adjoining the hole, a portion of the surface which has been pushed up.

As soon as the cause is determined, the method of repair to adopt is known. If the foundation is badly drained, the road should be opened, a trench cut to the side and back filled with coarse stone, the outlet to the trench being below the place to be drained. If there is evidence of considerable under water, a tile should be laid and stone filled about it. The surface stone should then be carefully relaid and tamped as firmly as possible. When the cause is due to a lot of extra small material, it is merely necessary to pick it loose and replace with stone of similar size to that in the surrounding surface, some of which should be loosened so that the new material will knit with the old portion.



Road constructed without a screenings or a dressing of



constructed without the use

A patch in a macadam surface, no matter for what reason made, should never have a square shaped end, that is, the place to be mended should be cut pointed in the direction traffic moves; for, if a square-ended patch is made, there will always be a ridge across the wheel way. If done skillfully, a macadam surface can be patched so that it can be scarcely detected after the traffic has compacted it.

In but few instances where crushed stone has been laid by the local commissioners without detailed supervision have the instructions given by the State Highway Commission been generally disregarded. On the contrary, the majority have undertaken to do the work as nearly according to instructions as possible. To many of the commissioners this character of work was entirely new and not until the practical results were had did the full significance of the different steps to be taken become apparent, so that we usually find if a second piece of macadam has been laid by the same officials, it is better and more economically done than the first piece.

TABLE NO. V.

Applications for Crushed Stone.

1908.

County.	Township.	Amount—cubic yards.
Bond	Burgess	1,200
Bond	Central	1,500
Bureau	Mineral	2,000
Bureau	Ohio	2,100
Cook	Orland	11,000
Cook	Rich	4,000
Cook	Wheeling	3,000
Crawford	Hutsonville	2,000
DeKalb	Sandwich	1,000
DeKalb	Somanauk	2,000
DeKalb	Victor	2,000
DuPage	Downers Grove	5,000
DuPage	Milton	3,000
Fayette	LaClede	1,000
Fayette	Avena	500
Grundy	Braceville	5,000
Grundy	Garfield	5,000
Grundy	Maine	2,000
Henderson	Raritan	135
Henry	Cornwall	40
Iroquois	Milford	5,000
Jackson	Fountain Bluff	2,000
Kendall	Na-aussay	2,000
Lake	West Deerfield	2,000
LaSalle	Adams	3,000
LaSalle	Mendota	4,000
LaSalle	Otter Creek	2,500
Livingston	Dwight	5,000
Livingston	Rooks Creek	75
Madison	New Douglas	2,000
Madison	Venice	1,000
Randolph	Central	90
Randolph	Prairie du Rocher	2,000
Richland	Olney	3,000
Tazewell	Cincinnati	3,000
Union	Road Dist. No. 4	1,000
Vermilion	Butler	2,000
White	Carmi	2,500
Whiteside	Erie	1,500
Will	Reed	3,000
Winnebago	New Milford	540
Total		100,680

Table No. V—Concluded.

1909.

County.	Township.	Amount—cubic yards.
Brown	Mt. Sterling	1,500
Boone	Belvidere	80
Champaign	Champaign	6,000
Christian	Taylorville	40
Cook	Bremen	3,000
Cook	Stickney	3,000
Crawford	Oblong	3,000
DeKalb	Sycamore	6,000
DuPage	Downers Grove	2,000
DuPage	Lisle	500
DuPage	Milton	1,840
DuPage	Naperville	1,000
Fayette	Avena	600
Ford	Patton	4,000
Grundy	Au Sable	2,000
Grundy	Braceville	1,000
Grundy	Greenfield	3,000
Grundy	Morris	4,000
Grundy	Waupansee	2,500
Henry	Atkinson	200
Henry	Weller	150
Iroquois	Beaver	3,000
Iroquois	Crescent	3,000
Iroquois	Middleport	10,000
Jackson	Grand Tower	5,000
Jackson	Sand Ridge	2,000
Kane	Compton	500
Kane	Kaneville	7,000
Kankakee	Ganier	10,100
Kankakee	Momence	2,500
Kankakee	Yellowhead	8,320
Lake	Ela	5,000
Lake	Shields	2,000
Lake	Waukegan	2,000
Lake	West Deerfield	3,000
Lee	Harmon	2,000
Lee	Wyoming	2,500
Macoupin	Brighton	1,700
Madison	Collinsville	3,000
Madison	Edwardsville	3,000
Madison	Helvetia	15,000
Madison	Venice	3,000
McDonough	Bushnell	4,000
Monroe	Road Dist. No. 8	1,000
Montgomery	North Litchfield	3,000
Peoria	Hollis	4,000
Peoria	Richwoods	10,000
Piatt	Blue Ridge	80
Randolph	Road Dist. No. 10	600
Rock Island	Canoe Creek	3,000
St. Clair	Centreville	10,000
St. Clair	Sugar Loaf	180
Saline	Harrisburg	5,000
Union	Road Dist. No. 11	2,000
Washington	Nashville	800
White	Hawthorne	5,000
Will	Crete	2,000
Will	Florence	2,500
Will	Frankfort	3,000
Will	Monee	2,500
Will	Manhattan	5,000
Will	New Lenox	10,000
Will	Peotone	12,000
Will	Reed	1,000
Winnebago	Winnebago	2,000
Total		227,690

TABLE No. VI.

Showing Extent of Distribution of Crushed Stone—1908-1909.

1908.

Shipped from—	Number counties receiving stone.	Number townships receiving stone.
Menard	13	21
Joliet	17	33
Total	30	54

1909.

Menard	16	23
Joliet	24	52
Total	40	75

TABLE No. VII.

Summary of Shipments of Crushed Stone.

1908.

Month.	Joliet—cubic yards.	Menard—cubic yards.
January	5,170	3,497
February	1,504	1,762
March	6,195	3,620
April	8,775	1,854
May	7,521	2,204
June	5,670	1,876
July	7,995	2,017
August	9,372	3,060
September	8,126	3,145
October	9,519	4,831
November	8,317	5,140
December	7,083	1,927
Total	85,247	34,193
Total output for 1908		120,240

Table No. VII—Concluded.

1909.

Month.	Joliet—cubic yards.	Menard—cubic yards.
January	5,208	598
February	6,391	3,165
March	4,544	4,716
April	11,293	3,706
May	10,015	2,349
June	8,903	4,097
July	10,104	3,467
August	9,430	2,220
September	9,947	3,038
October	11,559	4,230
November	8,611	3,160
December	2,780	3,258
Total	98,785	38,004
Total output for 1909		136,789

TABLE No. VIII.

Distribution of Crushed Stone Prepared at the Penitentiaries for Roads for Which the Commission Furnished Only Stone and General Supervision.

1908.

County.	Township.	Cubic yards of stone.	Length of macadam in feet.	Width of macadam in feet.	Thickness of macadam in inches.
Bond	Burgess	1,594	1,320	12	10
Bureau	Ohio	2,532	8,037	9	10–12
Cook	Wheeling	2,267	7,700	10	8
DeKalb	DeKalb	6,541	12,000	10	8
DuPage	Downers Grove	3,261	11,000	10	8
DuPage	Milton	1,038	3,500	10	8
Fayette	Avena	512	1,400	12	10
Grundy	Braceville	5,771	15,600	12	9
Grundy	Greenfield	2,352	6,000	10	12
Grundy	Gardner	2,501	8,500	10	8
Iroquois	Milford	3,161	10,700	10	8
Jackson	Murphysboro	2,961	10,100	10	8
Kankakee	Salina	1,426	4,125	10	8
Kendall	Na-aussay	1,334	3,240	12	10
Kendall	Seward	825	3,100	10	8
Lake	Ela	2,056	7,530	10	8
Lake	West Deerfield	925	3,470	10	8
LaSalle	Adams	2,357	8,910	8–10	10
LaSalle	Mendota	3,809	6,000	10	8
Madison	New Douglas	990	3,720	10	8
Monroe	Road Dist. No. 9	458	1,500	11–12	12
Montgomery	Hillsboro	2,803	9,500	10	8
Randolph	Road Dist. No. 12	1,075	3,675	10	8
Randolph	Road Dist. No. 9	500	1,700	10	8
Randolph	Prairie du Rocher	576	10,631	8	4
Randolph	Road Dist. No. 6	1,275	4,300	10	12
Sangamon	Williams	1,853	5,280	10	8
St. Clair	Sugar Loaf	2,705	10,801	12	12
Tazewell	Washington	1,411	1,400	10	10
			2,700	10½	8
Union	Road Dist. No. 4	2,354	10,010	10	8
Vermilion	Danville	550	1,600	12	8
Washington	Nashville	518	1,760	10	8
Will	Jackson	2,568	8,700	10	8
Will	New Lenox	1,643	5,600	10	8
Will	Peotone	2,211	3,360	10	10
Will	Reed	2,031	6,900	10	8
Will	Lockport	1,161	3,900	10	8
Will	Joliet	1,437	4,900	10	8
Will	Florence	641	2,180	10	8
Winnebago	Winnebago	620	2,790	9	10
Total for 1908		76,603	249,139		

Table No. VIII—Concluded.

1909.

County.	Township.	Cubic yards of stone.	Length of macadam in feet.	Width of macadam in feet.	Thickness of macadam in inches.
Bond	Central	5,424	5,280	12	10
Bureau	Ohio	2,532	4,600	8–9	8–9
Cook	Bremen	3,309	10,500	10	10
Cook	Orland	2,287	5,300	12	10
DeKalb	Somanauk	2,543	5,760	9	8
DeKalb	Victor	1,307	3,840	10	12–16
			300	18	8
DuPage	Downers Grove	2,172	7,400	10	8
DuPage	Milton	2,595	5,500	10–18	8
Fayette	Avena	266	1,095	10	8
Grundy	Greenfield	3,549	8,500	10–12	14
Grundy	Braceville	1,945	3,100	12	10
Grundy	Au Sable	1,457	7,920	8	8
Grundy	Gooselake	732	2,490	10	8
Grundy	Garfield	2,137	7,200	10	8
Iroquois	Milford	189*	640	10	.....
Jackson	Murphysboro	260	880	10	8
Jackson	Sand Ridge	902	2,000	12	10
Kane	Kaneville	1,085	6,000	8	7
Kankakee	Ganier	2,660	6,900	10	9–12
Kankakee	Rockville	232	790	10	8
Kendall	Na-aussay	297	2,740	10	4
Kendall	Seward	818	9,240	8	6
Lake	West Deerfield	3,393	11,500	10	8
Lake	Shields	2,208	7,700	10	8
LaSalle	Adams	1,039	4,050	10	8
Lee	Harmon	3,475	9,120	10	10
Madison	Helvetia	1,118	900	12	12
Macoupin	Brighton	177	600	10	8
McLean	Anchor	2,160	7,300	10	8
Montgomery	Litchfield	902	2,520	12	10
Monroe	Road Dist. No. 9	259	1,100	10	5
Randolph	Road Dist. No. 13	370	1,260	10	8
Randolph	Road Dist. No. 10	175	660	10	6–10
Rock Island	Canoe Creek	339	1,650	10	6
Sangamon	Williams	348	1,180	10	8
Washington	Nashville	525	2,700	12	10
White	Hawthorne	2,993	6,700	10	10
White	Carmi	1,906	6,500	10	8
Will	Joliet	1,612	5,500	10	8
Will	Lockport	6,954	2,350	10	8
Will	Monee	3,383	9,240	12	8
Will	Manhattan	4,124	23,600	8	5
Will	New Lenox	2,639	9,860	10	8
Will	Frankfort	4,361	10,098	12	10
			1,600	24	5
Will	Peotone	57*			
Will	Reed	2,077	4,620	9	8
Winnebago	Winnebago	1,977	8,696	9	10
Woodford	Metamora	598	1,614	12	5
			426	12	10
Total for 1909		81,608	251,019	.....	.....

* Completion of 1908 shipment.

EXPERIMENTAL ROADS.

In the report for 1907, page 73, an estimate of the cost of macadam roads was given. This estimate was based on the work that had been done up to that time, and included data on twelve roads, and the handling of a little over 44,000 cubic yards of crushed stone.

With the completion of the work for 1908 and 1909 there are available much additional data, from which the following tables of cost were constructed. These estimates are now based on the work for four years, including thirty-four separate pieces of construction, involving about forty miles of road. One or two pieces of work are omitted, as explained later, because this table includes only those roads on which the average haul was one mile or less.

The total amount of material handled, on which these estimates are made, is 104,000 cubic yards. The cost data were made up from the reports of the inspectors, and the following instructions to them will explain what has been included under each head.

TABLE No. IX.

Stone Shipments for Experimental Roads.

1908.

County.	Township.	Cubic yards.
Bond	Central	3,641
Cook	Orland	3,179
Cook	Rich	292
DuPage	Milton	3,421
Iroquois	Sheldon	2,588
Livingston	Dwight	6,127
Madison	Helvetia	3,776
Moultrie	E. Nelson	1,232
Richland	Olney	2,369
Vermilion	Danville	1,700
Will	Florence	2,099
Will	Lockport	1,900
White	Carmi	6,714
Total for 1908		39,038

Table No. IX—Concluded.

1909.

County.	Township.	Cubic yards.
Cook	Rich	2,590
Gallatin	Shawnee	3,001
Brown	Mt. Sterling	1,411
De Kalb	Sycamore	2,997
Grundy	Waupaunsee	2,099
Henry	Galva	3,431
Iroquois	Middleport	2,827
Iroquois	Beaver	1,280
Jersey	English and Jersey	4,898
Kankakee	Yellowhead	3,671
Livingston	Dwight	210
McDonough	Bushnell	3,519
Madison	Edwardsville	2,513
Madison	Collinsville	2,625
Madison	Venice	6,011
Richland	Olney	244
Saline	Harrisburg	2,966
Peoria	Richwood	2,119
Peoria	Hollis	708
Total for 1909		49,120

ILLINOIS HIGHWAY COMMISSION—INSTRUCTIONS TO ROAD INSPECTORS.

Inspectors on experimental roads are required to make a daily report of work done on Form No. 30. Care must be taken to make this report accurate in every respect because the information found on the daily reports is the basis for the final cost report of the road. Send a report for every day, whether there is work or not, reporting "No work on account of.....," on the days when there is no work. Never put more than one day's work on the same sheet.

The following interpretation of the meaning of the various items must be used in making out the report, and any item that cannot be properly listed under some one of the given headings must be given a special heading in one of the blank spaces below the standard headings.

Superintendence—The time of Highway Commissioners or other men employed by them to act as foremen.

Excavation—All labor, both men and teams used to move material for roadway in wheel scrapers, slips or wagons, including plowing to loosen such material.

Shaping Road Bed—The cost of shaping the bed for the stone after it has been put roughly to shape, including all work done with a plow or road machine for this purpose, hand labor in truing up the road bed and shoulders and cutting laterals. Any work done on shoulders in connection with getting out subgrade should be reported under shaping road bed.

Unloading Stone—The cost of unloading stone, either from cars to wagons or cars to storage pile, and for all sizes of stone. Report on these blanks the cost only after your arrival.

Hauling Stone—With teams: The cost of team and driver engaged in hauling stone of any size, either from cars or from storage piles. With engine: The cost of operator for engine at $3.00 per day and stoker at actual rate of pay and cost of hauling water for engine. Coal, oil and miscellaneous supplies for hauling engine must be separately recorded but not reported under hauling stone with engine.

Spreading Stone—Work done with grader, harrowing and hand spreading for all sizes of stone and for screenings, filling laterals and taking out depressions.

Trimming Shoulders and Side Roads—After lower course of stone is spread, shoulders are trued up for second course of stone. After second course of stone is placed, shoulders are again trimmed, ditches opened out, etc. All this work reported under this heading.

Rolling—Actual hours the roller works. If roller is equipped with odometer, reading of it must be reported also.

Loading Stone from Storage—Cost of loading stone of any size from storage pile.

On roads where a bituminous binder is used, the following items must also be reported:

Hauling Tar or Oil—Cost of teams and men used to manipulate the distributing wagon.

Spreading Tar or Oil—If material is spread by hand, report here the labor cost of such spreading. If a distributing wagon for spreading is used, include this item with hauling tar or oil.

Cars Received—Fill out completely the table of cars received, making allowance under cubic yards of two yards for cars loaded with a break.

Hauled—Report here yardage hauled, including excavated material. Report engine hauled material separate from team hauled. The information given here is used to check quantity of stone that inspector is using per 100 foot and must therefor be accurate.

Work Done—This is a progress report and must be carefully filled out every day. The information given here is used to check quantity of material being used per 100 foot and must be accurate.

Miscellaneous—Report them on "Final Report Blank."

TABLE NO. X.

Average Labor Cost of Macadam Construction from Data on Thirty-four Experimental Roads.

Total amount of crushed stone handled, 104,000 cu. yds.
Average haul of stone not to exceed one mile.

Work.	Cost.	Per cent.	Per cubic yard.
Excavation	$12,444 00	13.6	.....
Shaping road bed	5,652 00	6.2	.....
Trimming shoulders, etc	3,819 00	4.2	.....
Superintendence, watchman, etc	10,071 00	11.	.....
Unloading and hauling stone	43,229 00	47.4	$.415
Spreading stone	8,367 00	9.2	.081
Rolling	7,661 00	8.4	.074
Total	$91,243 00	100.0	$.570

It will be noticed in Table X that only labor items of expense are given. As the cost of crushed stone would vary from point to point, this has not been included; but it is evident with the quantities to be used, and the price known for a given place, the total cost of the work can be readily estimated, when in addition the labor cost is known.

All the roads from which the data were taken were constructed from stone furnished from the penitentiaries, on which the local commissioners paid only the freight. The exact cost of the freight in each instance is given under the itemized cost for the individual roads.

In comparing the cost in Table X with that given in the report for 1907, it will be noticed that the cost for handling a cubic yard of rock placed in the road is about the same. In 1907 the average cost was 60.5 cents; the work in 1908 and 1909 was handled slightly more cheaply, bringing the average cost down to 57 cents per cubic yard.

By reference to Table X it will be seen that unloading and hauling the stone, spreading it on the roadbed and rolling, constitutes 65 per cent of the entire cost of construction. Grading, shaping the roadbed, supervision, and incidental expenses making the balance. The roads which form the basis for this table were surveyed and a grade line established. Generally, no grades exceeding 4 per cent have been built, although in a few instances it was impractical to reduce the grade as low as this. It is evident that the cost of grading and shaping the roadbed will be more when the road is brought to an established grade line than it would be if the stone were merely placed on the existing roadbed without any attempt to cut the knolls and fill depressions, which are ordinarily encountered on most country roads.

Thickness of Macadam.

When a comparison is made with the cost of the individual roads actually built, it will be seen that in many instances the cost per square yard is considerably in excess of the estimated cost as computed from the table here given, although the cost for handling the crushed rock per cubic yard may not vary greatly. This is explained by the fact that the roads were constructed of various thicknesses. In general, it is believed that an 8-inch road, after rolling on about 10 inches of loose stone, is ample thickness on the average soil conditions, and that on sandy foundations even less thickness than this is sufficient. In many cases, however, the local officials did not think that 8 inches would be enough, and, inasmuch as they were paying for the material and it came cheap, they desired to take no chances and were quite willing to have the thickness increased. Under these circumstances, therefore, many of the roads were built somewhat thicker than would be absolutely necessary, but as the work is to be regarded as experimental, these varying conditions will prove, perhaps, to be without value. The point to be borne in mind, however, is that in the majority of instances where the cost is excessive, it is due to additional thickness and that the road could be duplicated for much less cost using less material, and would give a good road.

Width of Macadam.

Aside from the thickness of a road, its width is a controlling factor in the cost per mile. It is, therefore, evident that roads as narrow as consistent with proper service should be built. Experimental roads built by the State Highway Commission have varied from 30 feet to 10 feet. The majority, however, have been 12 feet wide. A careful observation of all these roads, and on many miles of other roads, shows that on the average country road the traffic does not use much over 8 to 9 feet of the actual road surface, and it might be stated in passing that this very fact is the cause of the greatest difficulty in the up-keep of the average country road. It costs far less to maintain a road 16 or 18 feet in width, on which the traffic is well distributed, than it does on an 8 or 9 foot road, on which the traffic is necessarily confined to one track. Wherever the traffic is so confined, for whatever reason, all the wear on the road is in one place, the surface does not wear evenly, depressions and ruts soon appear in which the water can collect to further soften the road and hasten its ultimate destruction. No road should be constructed so narrow that single horse traffic will not have a chance to spread sufficiently to bring the horse track of the vehicles at one side of the road in line with the wheels of the vehicles. As wagons have a tread of about 5 feet, there should be 2½ feet on either side of the center track or a width of 10 feet; in addition, there should also be at least a foot of stone between the outer edge of the wheel and the edge of the road, making a total of 12 feet as the minimum width.

Many communities have desired a much wider road than 12 feet, the first argument advanced being this is not wide enough for wagons to pass. It is pointed out in answer to this, that it is seldom loaded wagons meet; therefore, the unloaded one can turn aside with little difficulty. The fact that the side of the road is not traveled in bad weather, it does not become cut up, so that the occasional turning out for vehicles to pass is done without any difficulty or inconvenience, as practical experience shows. In fact, after the 12 foot road is built and used, there are few but what say it is too wide, as scarcely more than 8 feet of the road is used. Wherever roads are built wide enough to allow traffic to pass, the next practical width is 16 feet, and roads of this width have been constructed in the neighborhood of villages where it is evident there is considerable passing. Roads subjected to traffic of this description invariably remain in better condition and require less attention than roads with less traffic, which confines itself to one track.

Maintenance.

The maintenance of country roads must be divided between those who do the work of repairing the surface and those who use the road. Wherever the roads are used properly, that is, where no one drives in the track of the preceding vehicle, and there are no heavy loads or razor edge tires, the roads will be much more cheaply maintained and be in much better condition, whether they be macadam, gravel or earth roads.

It is as important to use a road property as it is to maintain it properly. To endeavor to bring this to the attention of people using the roads, small cards were printed and distributed to all who used the roads during the construction of the experimental roads. The card bore the following suggestions:

HOW TO KEEP THIS ROAD GOOD FOR YEARS.

DON'T DRIVE IN ONE TRACK—AVOID MAKING RUTS.

This road was constructed for your use.
If all use one place, all the wear will be in one place, and make a rut.
If you use a little care and do not drive exactly where the last wagon did the wear will be distributed, which will keep the surface smooth and the road will remain good for years. Otherwise it will soon be rutted and the smooth surface gone.
ISSUED BY ILLINOIS HIGHWAY COMMISSION.

Another factor which enters into the proper width the road is to be constructed, is the speed of the vehicles. Evidently more room would be required for fast moving traffic than slow moving, so that roads which are subjected to a large amount of automobile traffic should be built wider than roads which do not carry so much of this class of traffic. While we may not at present be warranted in building roads unduly wide, because of automobile traffic, yet its increase has become so rapid it would seem wise to provide, at least on the curves, additional width. At such points on the road, where the curve is at all abrupt, the width of the macadam should be not less than 18 feet. Roads 12 feet wide and 8 inches thick after rolling requires about 2,200 yards of stone per mile. This may be adopted as the standard for country road construction.

COST OF MACADAM ROADS.

The cost of a standard mile of road is estimated from Table X, thus the cost of hauling and placing the stone at 57½ cents per cubic yard would be $1,254.00. This part of the work is seen from the tables to be 65 per cent of the total labor cost, which makes the total labor cost about $1,930.00 per mile; to get the complete cost of the road, it is necessary to add to the labor cost of the material. It is evident that this will vary greatly. Assuming, however, that the material will cost $1.25 per cubic yard, f.o.b. cars at destination, and it requires 2,200 yards for the road, the material will cost $2,750.00 per mile for the standard road, making a total cost of $4,680.00.

On some sandy soils, 6 inch roads will be found sufficient, which will require less material, or about 1,650 cubic yards per mile of 12 feet width. The cost of placing 1,650 cubic yards of stone at 57 cents would be $940.50; the work preparing the roadbed, grading and the superintendence, while not quite as much will be nearly the same as for the thicker road; this cost, $676.00 will be added to the $940.50, making a total labor cost for a 6 inch road $1,616.50; the material at the same price as before assumed, $1.25 per yard, adds to the cost for the 6 inch road $2,062.50 per mile, or a total cost of $3,679.00.

These estimates, however, it should be kept in mind are based on the assumption that the average haul is one mile or less. An estimate of the average cost of roads, should assume that material would be hauled on an average at least three miles, which would increase the cost of handling the stone approximately 40 cents per cubic yard. The other items of spreading the material, superintendence, preparing the road-bed would not be greatly increased, if at all. This would then add $880.00 to our standard 12 foot road, 8 inches thick, which requires 2,200 cubic yards of material, bringing the labor cost to an average of $2,810.00 per mile, and the cost of the material, as before assumed at $1.25 per yard, makes the average cost of our completed road $5,560.00 for the standard 12 foot road 8 inches thick. The 6 inch road on an average of three mile haul is similarly found, assuming the cost of material at $1.25 per yard, to average $4,339.00.

Practically the same conclusions regarding the construction of macadam roads are reached as noted in the report for 1907, where it was stated that a lower estimate on the average cost would be arrived at by reducing the width of the road, which, on the whole, it is believed would be advisable in many instances. The objection to the narrow road has always been that there is not room enough for traffic to spread out, so that it necessarily would be confined to one track and, therefore, that portion of the road would receive an undue amount of wear and consequently would be more expensive to maintain. It has been a general recommendation to build no roads narrower than 12 feet. As a matter of fact, on all roads so far observed in Illinois, carrying only the ordinary country road traffic, there is no tendency for this traffic to spread over the road, whether it is 12 feet wide or wider. The vehicles invariably keep to the center and use at the most but 8 or 9 feet of width. Therefore, if a 12 foot road is to receive the same treatment as it would if it were but a 10 foot road, there does not seem to be any reason to pay the extra first cost of making the additional 2 feet in width.

Methods of Construction.

In most cases the same methods of construction were followed as were used previously in the construction of roads under the supervision of the Commission.

In general the small size stone was used in the lower course and the larger size in the top course, each course being thoroughly harrowed. This feature of the construction, harrowing of the material, is believed to be an important one and one which affects not only a better consolidation of the material but more effectively and cheaper than is done in the ordinary way by merely spreading the stone and submitting it to the roller without previously harrowing. On all work done with the harrow, where the stone was harrowed before rolling, it was found that the stone was compacted with about 50 per cent of the amount of rolling that would otherwise be needed.

A number of stretches of the road were built with the smaller size material, but with the average limestone found in Illinois it is believed

that a road surface composed of 2½ inch size pieces will give on the average the best results. Park roads and driveways carrying only light traffic probably could be kept in a better state of repair by using inch and a half size material, but on streets and roads subjected to heavier traffic 2½ inch size pieces, and even as large as 3 inches, may be used to good advantage. The greatest difficulty incurred in the construction of the State roads has been with the Joliet material, which will not by itself bind, and some pieces of roads constructed with this material, which have been subjected to peculiar conditions, have revealed and been practically destroyed. Wherever it has been possible to do so a gravel binder, or some material other than the stone screenings has been secured to give a proper bond to the surface. Such material, however, has not always been secured, as results show. In these instances during the dry weather the material will blow away and the showers will wash between the stones, leaving the road surface rough, and the next dry spell the top layer becomes loosened by the horses hoofs, and the road ravels. Much less difficulty of this kind has been encountered with the material from the Chester penitentiary, which has very much better binding qualities.

On the roads where bituminous compounds were used, there are several special features involved in their construction which are described in connection with the cost of these particular roads.

During the seasons of 1908 and 1909 the work progressed with reasonable dispatch, there being a few unavoidable delays in the work. The stone shipments were fairly regular and the weather was as favorable as could be expected in Illinois. Work in many cases was much facilitated, due to the fact that a quantity of stone was shipped in and unloaded by the commissioners during the preceding winter so as to have it available when the season opened for construction in the spring. Experience indicates that if half the stone is shipped in and unloaded on the ground, the total labor cost for the construction will be less than if the stone is unloaded and hauled as it comes in and the work will require much less time. This is accounted for by the fact that the shipments are sure to be irregular and the men more or less intermittently employed so that it is impossible to get an efficient force. There are also some delays every day on account of switching of cars which cut down the apparent saving where stone is not rehandled. In general, it will be seen that rather higher rates of pay were necessary during the season of 1909 than any previous season, but that the cost of construction has not increased very materially.

TABLE No. XI.

Applications for Experimental Road Work.

1908.

County.	Township.	Length of road —miles.
Bond	Central	1
Cook	Rich	1
Cook	Wheeling	1
Crawford	Hutsonville	¾
Clinton	Looking Glass	.....
DuPage	Downers Grove	1
DuPage	Milton	.....
DuPage	Naperville	1
Grundy	Garfield	1
Hancock	Rock Creek	½
Iroquois	Milford	1
Iroquois	Middleport	1
Iroquois	Sheldon	2
Kane	Batavia	.....
Lake	West Deerfield	1
Mason	City of Mason	½
Montgomery	North Litchfield	½
Pike	Pleasant Vale	.....
Richland	Olney	1.9
Sangamon	Williams	⅛
Sangamon	Woodside	1
Tazewell	Cincinnati	2
White	Carmi	8
Whiteside	Portland	1½
Will	Florence	1
Will	Frankfort	1

1909.

County.	Township.	Length of road —miles.
Brown	Mt. Sterling	½
Christian	Prairietown	1
Clay	Clay	2½
Crawford	Hutsonville	1
Crawford	Oblong	1
Coles	East Oakland	1
De Kalb	Sycamore	1
Edgar	Buck	1
Ford	Patton	1
Gallatin	Shawnee	1
Grundy	Wauponsee	1
Henry	Galva	1½
Iroquois	Beaver	1
Iroquois	Crescent	1
Jackson	Sand Ridge	1
Jackson	Grand Tower	2
Jersey	English	1
Kane	Elburn	2
Kankakee	Yellowhead	2
McDonough	Bushnell	1
McLean	Arrowsmith	1
Madison	Collinsville	1
Madison	Edwardsville	1
Moultire	East Nelson	1
Peoria	Hollis	1⅞
Peoria	Richwoods	4½
Saline	Harrisburg	1⅝
Will	Monee	1

Experimental Roads Constructed in 1908.

GREENVILLE.

South Road in Central Township, Bond County.

This road was constructed in 1907 but rutted somewhat during winter. It was thought advisable to spike up these ruts and add enou stone to bring the surface to the proper shape. One mile was resurfa in this way and following is the itemized statement of the cost:

Length of road resurfaced	5280 f
Width of macadam	12 f
Cubic yards of stone used	95 f

Cost of pay—Men, 15 cents per hour; man and team, 25 cents per hour.

COST OF LABOR AND SUPPLIES.

Hauling stone	$37
Rolling and sprinkling	34
Watchman and miscellaneous labor	3
Coal, oil and miscellaneous supplies	6
Freight on stone	42
Total	$124

GREENVILLE.

Fourth Street Road in Central Township, Bond County.

Part of this road was within the city of Greenville and part withc It included portions of Fourth and College streets and from the cor of College and Sixth streets it led in a northwesterly direction fr town, the total length being a little more than a mile. The road hilly, having a grade of 9 feet in the hundred for a part of the distar The soil is a brown loam in places and at other points sandy. St for the improvement was furnished from the penitentiary at Men and was shipped in and unloaded during the spring before work the road began. The freight on the stone and the cost of prepar the roadbed and placing the stone was paid from a fund provided b special tax levy. The macadam was built 16 feet wide. Two sm concrete culverts were also built.

The following table is an itemized statement of the cost of this ro

Length of road	6140 f
Width of macadam	16 f
Macadam laid	10,915 square ya
Stone in road	2950 cubic ya
Average haul of stone	3000 f

Rate of pay—Men, 17½ cents; man and team, 37½ cents per hour.

COST OF LABOR AND SUPPLIES.

Superintendence	$ 168 00
Excavation	1094 00
Shaping road bed	135 14
Unloading stone	210 56
Hauling stone	668 06
Spreading stone	127 13
Trimming shoulders and side roads	51 25
Rolling and sprinkling	206 30
Watchman and miscellaneous labor	38 75
Coal, oil and supplies	66 59
Freight on stone	2772 66
Total	$5538 44

COST PER CUBIC YARD FOR PLACING STONE.

Unloading stone	$0.073
Hauling stone	.226
Spreading stone	.043
Rolling and sprinkling	.070
Watchman and miscellaneous labor	.013
Coal, oil and supplies	.022
Total	$0.447

COST PER SQUARE YARD FINISHED MACADAM.

Superintendence	$0.0150
Shaping road bed	.0123
Trimming shoulders and side roads	.0047
Placing stone	.1210
Freight on stone	.2540
Total	$0.407

ORLAND.

English Settlement Road, Orland Township, Cook County.

This road leads south from Orland to Tinley park and was macadamized for a distance of 7,510 feet. The country through which it runs is rolling, and there were grades on the road of 8 to 9 feet to the hundred. The soil is yellow clay. Stone for the improvement was furnished from the penitentiary at Joliet, and a part was received and unloaded before work began. The grades were reduced so as not to exceed 6 feet to the hundred.

The road was macadamized 12 feet. The freight and the cost of placing the stone was paid from the township funds. A good bonding gravel was used for a surface dressing on the road. Two concrete culverts were built to replace old wooden structures.

Following is an itemized statement of the cost of this road:

Length of road.....7510 feet
Width of macadam.....12 feet
Amount of macadam laid.....10,013 square yards
Amount of stone in road.....3153 cubic yards
Average haul of stone.....3000 feet
Rate of pay—Men, 17½ cents per hour; man and team, 35 cents per hour.

COST OF LABOR AND SUPPLIES.

Superintendence	$ 78 15
Excavation	603 36
Shaping road bed	29 25
Unloading stone	256 11
Hauling stone	862 01
Spreading stone	163 00
Trimming shoulders and side roads	55 38
Rolling and sprinkling	119 50
Watchman and miscellaneous labor	124 00
Coal, oil and supplies	64 92
Freight on stone	1907 00
Gravel binder delivered	60 00
Total	$4322 68

COST PER CUBIC YARD FOR PLACING STONE.

Unloading stone	$0.081
Hauling stone	.273
Spreading stone	.0516
Rolling and sprinkling	.0376
Watchman and miscellaneous labor	.038
Coal, oil and supplies	.0205
Total	$0.5017

COST PER SQUARE YARD FINISHED MACADAM.

Superintendence	$0.0078
Excavation	.0603
Shaping road bed	.0029
Trimming shoulders and side roads	.0055
Placing stone	.1589
Gravel binder	.0060
Freight on stone	.1900
Total	$0.4314

WHEATON.

Chicago-Batavia Road in Milton Township, DuPage County.

This road passes through the south edge of Wheaton and the work done began at the intersection of the Chicago-Batavia road and Naperville street in Wheaton and extends for 6,600 feet eastward.

The country is slightly rolling but the road was graded up until practically level except for two slight grades near Wheaton. Stone for the work was furnished from the penitentiary at Joliet and part of it was shipped and hauled to storage piles on the road before the work began. A part of the road is in the village of Wheaton, and the freight

Settlement road before im-

Settlement road. Limestone,

and the cost of preparing this part of the road and placing the stone on it was paid by the property owners along the road. The freight on stone used for the remainder of the road was paid by subscription, and the cost of placing the stone was paid from the township funds. A top dressing of a good bonding gravel was used on the finished road.

This road is subjected to a large amount of automobile traffic, the effect of which soon demonstrated that an ordinary water-bound macadam could not be successfully maintained on this piece of road. After two years' service, the road has become much worn. It should be resurfaced with a bituminous macadam.

The following table is an itemized statement of the cost of this road:

Length of road	6,600 feet
Width of macadam	14 feet
Macadam laid	10,270 square yards
Stone in road	3,421 cubic yards
Average haul of stone	1¼ mile
Rate of pay	men, 20 cents; man and team, 50 cents per hour

COST OF LABOR AND SUPPLIES.

Superintendence	$ 338 75
Excavation	966 69
Shaping road bed	162 65
Unloading stone	398 83
Hauling stone	1813 57
Spreading stone	242 46
Trimming shoulders and side roads	136 44
Rolling and sprinkling	261 00
Watchman and miscellaneous labor	20 66
Coal, oil and supplies	126 11
Gravel binder delivered	168 30
Freight on stone	1872 00
Total	$6507 46

COST PER CUBIC YARD FOR PLACING STONE.

Unloading stone	$0.116
Hauling stone	.530
Spreading stone	.071
Rolling and sprinkling	.076
Watchman and miscellaneous labor	.006
Coal, oil and supplies	.037
Total	$0.836

COST PER SQUARE YARD FINISHED MACADAM.

Superintendence	$0.033
Excavation	.094
Shaping road bed	.015
Trimming shoulders and side roads	.013
Placing stone	.285
Gravel binder delivered	.016
Freight on stone	.182
Total	$0.638

SHELDON.

Efner Road in Sheldon Township, Iroquois County.

This road extends from Sheldon east to the Indiana state line and was macadamized for a distance of 6,000 feet from Sheldon. Subsequent to the building of the experimental road, the local commissioners extended the macadam to the village of Efner. The road is level and the soil a black loam. Stone for the improvement was furnished from the penitentiary at Joliet. A part of the stone was shipped and unloaded before the work began.

The macadam was made 12 feet wide. The freight and the cost of preparing the road and placing the stone was paid from the township funds except for a small amount of donated hauling. A good bonding gravel was spread on the finished macadam for a top dressing and binder.

The following table is an itemized statement of the cost of this road:

Length of road	6,000 feet
Width of macadam	12 feet
Macadam laid	8,000 square yards
Stone in road	2,544 cubic yards
Average haul of stone	1½ mile
Rate of pay	men 20c, man and team 40c, per hour

COST OF LABOR AND SUPPLIES.

Superintendence	$ 56 40
Shaping road bed	56 70
Unloading stone	220 00
Hauling stone	836 44
Spreading stone	208 70
Trimming shoulders and side roads	60 75
Rolling and sprinkling	72 50
Watchman and miscellaneous labor	72 25
Coal, oil and supplies	93 33
Gravel binder delivered	617 41
Freight on stone	1,773 40
Total	$4,067 88

COST PER CUBIC YARD FOR PLACING STONE.

Unloading stone	$0.086
Hauling stone	.328
Spreading stone	.082
Rolling and sprinkling	.032
Watchman and miscellaneous labor	.032
Coal, oil and supplies	.037
Total	$0.597

COST PER SQUARE YARD FINISHED MACADAM.

Superintendence	$0.007
Shaping road bed	.007
Trimming shoulders and side roads	.008
Placing stone	.186
Gravel binder	.076
Freight on stone	.221
Total	$0.507

MENDOTA.

Washington Street Road, Mendota Township, LaSalle County.

This road was constructed in 1907 but on account of an error was not included in the 1907 report. The road leads west from Mendota to the Bureau county line and was macadamized for a distance of 6,000 feet, beginning at the town limits. The country is rolling, the road having grades of from 2 feet to 5 feet to the hundred. The soil, for a part of the distance, is black loam and the remainder is clay. Stone was furnished from the penitentiary at Joliet. The road was macadamized for a width of 12 feet. Part of the stone was shipped and unloaded before the work began. A large part of the hauling was donated; the remainder of the expense of placing the stone and the freight was paid from the township funds. It was recommended that a good bonding gravel be used on the road as surface dressing to prevent the road from raveling; but it was not done, and the road raveled to some extent during the dry weather of the summer of 1908.

The following table is an itemized statement of the cost of the road:

Length of road	6,000 feet
Width of macadam	12 feet
Macadam laid	8,000 square yards
Amount stone on road	3,440 cubic yards
Average haul of stone	½ mile
Rate of pay	men 17½c per hour, teams 35c per hour

COST OF LABOR AND SUPPLIES.

Superintendence	$ 195 00
Excavation	469 00
Shaping road bed	240 00
Unloading stone	505 00
Hauling stone	1,048 82
Spreading stone	307 20
Trimming shoulders and side roads	199 80
Rolling and sprinkling	166 00
Coal, oil and supplies	50 10
Freight on stone	2,339 50
Total	$5,520 42

COST PER CUBIC YARD FOR PLACING STONE.

Unloading stone	$0.147
Hauling stone	.310
Spreading stone	.089
Rolling and sprinkling	.048
Coal, oil and supplies	.015
Total	$0.609

COST PER SQUARE YARD FINISHED MACADAM.

Superintendence	$0.024
Excavation	.059
Shaping road bed	.030
Trimming shoulders and side roads	.025
Placing stone	.259
Freight on stone	.292
Total	$0.689

DWIGHT.

Mazon Avenue Road in Dwight Township, Livingston County.

Mazon Avenue road is a continuation of Mazon avenue in Dwight and the macadam begins at the city limits and extends one mile west. The road is level and the soil a black loam. Stone was furnished from the penitentiary at Joliet, and part of it was unloaded before the construction began. The road is 12 feet wide. The freight and the cost of preparing the road and placing the stone was paid in part from the township funds and in part from a fund raised by subscription. Bonding gravel was used for a surface dressing.

The following table is an itemized statement of the cost of the road:

Length of road	5,280 feet
Width of macadam	12 feet
Amount of macadam laid	7,050 square yards
Amount of stone in road	2,400 cubic yards
Average haul of stone	1 mile

COST OF LABOR AND SUPPLIES.

Superintendence	$ 89 75
Shaping road bed	22 20
Unloading stone	14 00
Hauling stone	1,139 40
Spreading stone	207 90
Trimming shoulders and side roads	36 50
Rolling and sprinkling	131 00
Watchman and miscellaneous labor	9 00
Freight on stone	720 00
Total	$2,369 75

COST PER CUBIC YARD FOR PLACING STONE.

Unloading stone Hauling stone	$0.483
Spreading stone	.0865
Rolling and sprinkling	.0545
Watchman and miscellaneous labor	.0038
Total	$0.6278

COST PER SQUARE YARD FINISHED MACADAM

Superintendence	$0.013
Shaping road bed	.003
Trimming shoulders and side roads	.005
Placing stone	.215
Freight	.110
Total	$0.346

HIGHLAND.

Trenton Road in Helvetia Township, Madison County.

This road leads south from Highland and was macadamized for a distance of one mile beginning near the mill at the southwest corner

of town. The country is rolling and the road has several grades from 2 to 7 feet in the hundred. The soil is a yellow clay. Stone for the improvement was furnished from the penitentiary at Menard and a part of it was shipped in and unloaded before the work began. The macadam was built 12 feet wide. The freight and the cost of preparing the road and placing the stone was paid from a fund raised by a special tax levy.

The necessary grading on this road was done by the township commissioners previous to the arrival of the State outfit, but the work was done according to the plans of the State Highway Commission, and the cost is included in the following itemized table:

Length of road	5,280 feet
Width of macadam	12 feet
Macadam laid	7,040 square yards
Average haul of stone	½ mile
Stone in road	1,981 cubic yards
Rate of pay	men, 17½c; man and team, 35c per hour

COST OF LABOR AND SUPPLIES.

Superintendence	$ 46 00
Excavation	600 00
Shaping road bed	163 33
Unloading stone	36 75
Hauling stone	537 50
Spreading stone	114 90
Trimming shoulders and side roads	79 36
Rolling and sprinkling	69 60
Coal, oil and supplies	56 30
Freight on stone	2,195 21
Total	$3,898 95

COST PER CUBIC YARD FOR PLACING STONE.

Unloading stone	$0.0180
Hauling stone	.2720
Spreading stone	.0580
Rolling and sprinkling	.0352
Coal, oil and supplies	.0284
Total	$0.4116

COST PER SQUARE YARD FINISHED MACADAM.

Superintendence	$0.006
Excavation	.085
Shaping road bed	.023
Trimming shoulders and side roads	.012
Placing stone	.115
Freight on stone	.312
Total	$0.555

HIGHLAND.

Sebastopol Road in Helvetia Township, Madison County.

In 1907 a gravel road was built leading east from Highland for a distance of 3,000 feet. The gravel used was not of the quality recommended by the State Highway Commission, and the local commissioners were advised that it would not make a successful road. The results were as anticipated, one winter demonstrating the unfitness of the material. During 1908 the road was resurfaced with a 4-inch layer of 3-inch stone, the gravel being shaped for the foundation course. Stone for the resurfacing was furnished from the penitentiary at Menard, and the cost of freight and placing the stone was paid from township funds. The macadam was made 12 feet wide and 5 inches thick.

The following table is an itemized statement of the cost of the work:

Length of road, resurfaced	3,000 feet
Width of macadam	12 feet
Macadam, resurfaced	4,000 square yards
Stone, used in resurfacing	440 cubic yards
Rate of pay	men, 20c per hour; man and team, 40c per hour

COST OF LABOR.

Superintendence	$ 10 00
Reshaping old road	22 50
Unloading stone	17 00
Hauling stone	181 50
Spreading stone	41 80
Trimming shoulders and side roads	3 75
Rolling and sprinkling	23 75
Watchman and miscellaneous labor	12 00
Total	$312 30

COST PER CUBIC YARD FOR PLACING STONE.

Unloading stone	$0.038
Hauling stone	.41
Spreading stone	.095
Rolling and sprinkling	.054
Watchman and miscellaneous labor	.027
Total	$0.624

COST PER SQUARE YARD FOR RESURFACING MACADAM.

Superintendence	$0.0025
Shaping road bed	.0056
Trimming shoulders and side roads	.0009
Placing stone	.069
Total	$0.0780

SULLIVAN.

Masonic Home Road in East Nelson Township, Moultrie County.

In 1907 work was begun on a road leading from the pavement at the city limits of Sullivan east to the Masonic Home. The work was

unfinished when construction was discontinued for the season. In 1908 the road was completed to the cross roads near the Masonic Home, a length of 2,800 feet being built during this season. The road is practically level and the soil a black gumbo and was macadamized for a width of 12 feet. The stone for the improvement was furnished from the penitentiary at Joliet. On a part of this road a local gravel was used instead of screenings as a filler and binder for the top course. On the remainder, a surface dressing of local gravel was used in addition to the limestone screenings. Water cost 50 cents per tank of 500 gallons, and was hauled a distance of one and one-half miles, increasing materially the cost of this feature of the work.

The following table is an itemized statement of the cost of the road:

Length of road	2,800 feet
Width of macadam	12 feet
Macadam laid	3,734 square yards
Amount of stone on road	974 cubic yards
Average haul of stone	1¾ miles
Rate of pay	men, 15c per hour; teams, 37½c per hour

COST OF LABOR AND SUPPLIES.

Superintendence	$ 37 00
Excavation	12 95
Shaping road bed	58 80
Unloading stone	97 40
Hauling stone	487 00
Spreading stone	93 48
Trimming shoulders and side roads	70 38
Rolling and sprinkling	108 62
Watchman and miscellaneous labor	48 75
Coal, oil and supplies	73 36
Freight on stone	1,268 29
Gravel binder delivered	300 00
Total	$2,656 03

COST PER CUBIC YARD FOR PLACING STONE.

Unloading stone	$0.100
Hauling stone	.500
Spreading stone	.097
Rolling and sprinkling	.110
Watchman and miscellaneous labor	.050
Coal, oil and supplies	.070
Total	$0.927

COST PER SQUARE YARD FINISHED MACADAM.

Superintendence	$0.010
Excavation	.003
Shaping road bed	.016
Trimming shoulders and side roads	.019
Placing stone	.241
Gravel binder delivered	.081
Freight on stone	.340
Total	$0.710

DANVILLE.

Lesure's Lane Road, Danville Township, Vermilion County.

Lesure's lane is a cross road south of Danville between the Georgetown road and Glenwood cemetery, a distance of three-fourths of a mile. There are no long hills, but several slight grades and two hills of about 3 per cent grade. The soil is black loam but had been graveled some years previous. The stone was put on top of this gravel as far as possible, the macadam being 12 feet wide and from 6 to 8 inches thick, finished. Stone for the work was furnished from the penitentiary at Joliet and was shipped in and unloaded during the spring. The freight, cost of unloading the stone, and placing it on the road was paid from the township funds. The township commissioners failed to report the exact cost of unloading the stone and the amount of freight, but the amounts given in the cost statement are sufficiently close for the purpose.

A good bonding gravel was used as a surface dressing. Enough stone was furnished for a mile of road, but only three-fourths of a mile was built as an experimental road. The local commissioners used the remainder of the stone to build about one-fourth of a mile additional road, putting the stone down without the use of a roller.

The following table is an itemized statement of the cost of the road:

Length of road	3,960 feet
Width of macadam	12 feet
Macadam laid	5,280 square yards
Amount of stone on road	1,700 cubic yards
Amount of stone unloaded in storage	1,700 cubic yards
Average haul of stone	¾ mile
Rate of pay	men, 17½c per hour; teams, 35c per hour

COST OF LABOR AND SUPPLIES.

Superintendence	$ 90 00
Excavation	44 19
Shaping road bed	65 62
Unloading stone, including reloading	315 00
Hauling stone	626 65
Spreading stone	117 20
Trimming shoulders and side roads	26 00
Rolling and sprinkling	127 96
Watchman and miscellaneous labor	99 85
Coal, oil and supplies	28 45
Freight on stone	1,650 00
Gravel binder	82 60
Total	$3,273 52

COST PER CUBIC YARD FOR PLACING STONE.

Unloading stone	$0.085
Hauling stone, including reloading	.405
Spreading stone	.069
Rolling and sprinkling	.075
Watchman and miscellaneous labor	.059
Coal, oil and supplies	.016
Total	$0.709

COST PER SQUARE YARD FINISHED MACADAM.

Superintendence	$0.017
Excavation	.0084
Shaping road bed	.0124
Trimming shoulders and side roads	.0049
Placing stone	.2494
Freight on stone	.3130
Gravel binder delivered	.0160
Total	$0.6211

CARMI.

Cemetery and Fair Grounds Roads, Carmi Township, White County.

Two roads were constructed at Carmi during 1908, known respectively as the Fair Grounds road and the Cemetery road.

The Fair Grounds road leads in a southwesterly direction from town through gently rolling country. It was macadamized for a length of 5,780 feet. There are a few grades of from 1 per cent to 2 per cent. The soil is a light yellow clay.

The Cemetery road leads in a northwesterly direction from the town, and was macadamized for a distance of 6,900 feet with grades from 1 per cent to 4 per cent. The soil is a light yellow clay. One concrete bridge of 12-foot span was built.

The stone for both of these roads was furnished from the penitentiary at Menard and a part of it was shipped in and unloaded before the work on the road began.

These roads were built 12 feet wide. The freight on the stone and cost of placing it on the road was paid from a fund raised by a special tax levy. A part of this special fund remains unexpended, and will be used during the season of 1909 in extending the two roads built in 1908.

The following tables are itemized statements of the cost of the two roads:

FAIR GROUNDS ROAD.

Length of road	5,780 feet
Width of macadam	12 feet
Macadam laid	7,709 square yards
Stone in road	2,156 cubic yards
Average haul of stone	¾ mile
Rate of pay	men, 12½c; man and team, 25c per hour

COST OF LABOR AND SUPPLIES.

Superintendence	$ 137 28
Excavation	295 67
Shaping road bed	152 74
Unloading stone	93 00
Hauling stone	627 55
Spreading stone	277 33
Trimming shoulders and side roads	5 75
Rolling and sprinkling	133 80
Watchman and miscellaneous labor	90 49
Coal, oil and supplies	40 56
Freight on stone	2,350 00
Total	$4,204 17

COST PER CUBIC YARD FOR PLACING STONE.

Unloading stone	$0.043
Hauling stone	.292
Spreading stone	.127
Rolling and sprinkling	.066
Watchman and miscellaneous labor	.042
Coal, oil and supplies	.019
Total	$0.589

COST PER SQUARE YARD FINISHED MACADAM.

Superintendence	$0.0178
Excavation	.0383
Shaping road bed	.0199
Trimming shoulders and side roads	.0007
Placing stone	.1640
Freight on stone	.3050
Total	$0.5457

CEMETERY ROAD.

Length of road	6,900 feet
Width of macadam	12 feet
Macadam laid	9,200 square yards
Stone in road	2,810 cubic yards
Average haul of stone	¾ mile
Rate of pay.	men, 12½c; man and team, 25c per hour

COST OF LABOR AND SUPPLIES.

Superintendence	$ 104 94
Excavation	409 73
Shaping road bed	164 34
Unloading stone	273 00
Hauling stone	860 45
Spreading stone	291 30
Trimming shoulders and side roads	50 44
Rolling and sprinkling	196 38
Watchman and miscellaneous labor	171 89
Coal, oil and supplies	57 74
Freight on stone	3,050 00
Total	$5,630 20

COST PER CUBIC YARD FOR PLACING STONE.

Unloading stone	$0.0970
Hauling stone	.3080
Spreading stone	.1035
Rolling and sprinkling	.0700
Watchman and miscellaneous labor	.0610
Coal, oil and supplies	.0200
Total	$0.6595

COST PER SQUARE YARD FINISHED MACADAM.

Superintendence	$0.012
Excavation	.044
Shaping road bed	.018
Trimming shoulders and side roads	.005
Placing stone	.201
Freight on stone	.332
Total	$0.612

ELWOOD.

Elwood-Symerton Road, Florence Township, Will County.

This work is on the Elwood-Symerton road and begins on the line between Jackson and Florence townships, thence extending one mile south. The country is flat and the road practically level. The soil is black gumbo. Stone was furnished from the penitentiary at Joliet and was shipped to Elwood. A part was hauled to the road by teams and a part in special wagons drawn by a traction engine. (See cut.) The macadam road was built 12 feet wide. The freight and cost of preparing the road and placing the stone was paid partly from township funds, partly from a special tax levy. A surface dressing of a good bonding gravel was used on this road.

The following table is an itemized statement of the cost of the work:

Length of road	5,292 feet
Width of macadam	12 feet
Macadam laid	7,056 square yards
Stone used	2,011 cubic yards
Average haul of stone	3¾ mile
Rate of pay	men, 20c; teams, 40c per hour

COST OF LABOR AND SUPPLIES.

Superintendence	$ 90 00
Excavation	106 40
Shaping road bed	63 60
Unloading stone	196 40
Hauling stone	688 21
Spreading stone	229 75
Trimming shoulders and side roads	57 50
Rolling and sprinkling	147 25
Watchman and miscellaneous labor	58 20
Coal, oil and supplies	70 83
Freight on stone	1,047 18
Gravel binder delivered	65 36
Total	$2,820 68

COST PER CUBIC YARD FOR PLACING STONE.

Unloading from cars	$0.098
Hauling stone	.340
Spreading stone	.113
Rolling and sprinkling	.073
Watchman and miscellaneous labor	.029
Coal, oil and supplies	.035
Total	$0.688

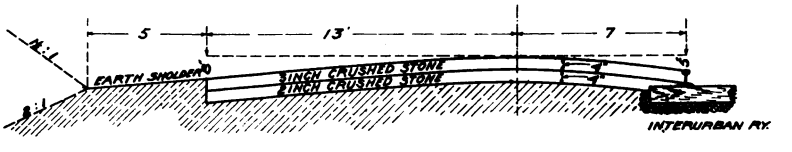
COST PER SQUARE YARD FINISHED MACADAM.

Superintendence	$0.013
Excavation	.015
Shaping road bed	.009
Trimming shoulders and side roads	.008
Placing stone	.198
Gravel binder delivered	.010
Freight on stone	.149
Total	$0.402

LOCKPORT.

Joliet-Lockport Road in Lockport Township, Will County.

This road leads north from Joliet to Lockport. The macadam work began at the Lockport township line, and ran north in Lockport township for a distance of 2,900 feet. The country is rolling and there are several hills on the road, the grades ranging from 2 to 8 feet in a hundred. The soil is yellow clay. An electric line at one side of the road determined the grades. The accompanying cut of the cross section of the road shows the special features of the construction.



JOLIET - LOCKPORT ROAD

Figure 2.

Stone for the work was furnished from the penitentiary at Joliet and was hauled in wagons from the crusher. The cost of the work was paid from the township funds. The old roadway was rough and washed uneven by the rains so that a large amount of filling was necessary to bring the road to the proper cross section. The average haul was about one-half mile.

Length of road	2,900 feet
Width of macadam	20 feet
Macadam laid	6,444 square yards
Amount of stone in road	1,900 cubic yards
Amount of excavation (filling)	2,000 cubic yards
Average haul of fill material	½ mile
Average haul of stone	½ mile
Rate of pay	men, 17½c per hour; teams, 35c per hour

Naperville Experimental road, DuPage County. Slag macadam, asphaltic binder. Built, 1908. Photographed, August, 1910.
(Section 2.)

COST OF LABOR AND SUPPLIES.

Superintendence	$ 62 80
Excavation	618 29
Shaping road bed	60 37
Hauling stone	269 86
Spreading stone	107 45
Trimming shoulders and side roads	91 89
Rolling and sprinkling	65 75
Watchman and miscellaneous labor	83 38
Coal, oil and supplies	68 90
Gravel binder	82 00
Total	$1,510 69

COST PER CUBIC YARD FOR PLACING STONE.

Hauling stone	$0.142
Spreading stone	.092
Rolling and sprinkling	.035
Watchman and miscellaneous labor	.044
Coal, oil and supplies	.036
Total	$0.349
Cost per cubic yard for 2,000 yards excavation	.31

COST PER SQUARE YARD FINISHED MACADAM.

Superintendency	$0.009
Snaping road bed	.009
Trimming shoulders and side roads	.001
Placing stone	.102
Cost of bonding gravel delivered	.013
Total	$0.134

Experimental Roads Constructed in 1909.

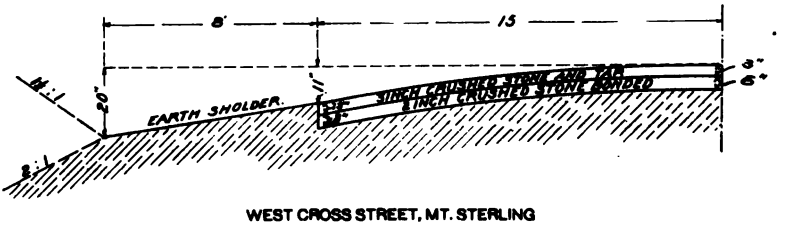
MT. STERLING.

West Cross Street, Mt. Sterling Township, Brown County.

This road begins at the end of the pavement at the intersection of Main and West Cross streets in Mt. Sterling and extends to the Wabash depot, a distance of 2,020 feet. It was built to demonstrate the suitability of a bituminous macadam for pavement in a small town. The soil on which the road was built is black gumbo and slopes gently to the southward. The macadam was made 30 feet in width and treated with Tarvia X. Stone for the work was purchased from various commercial quarries. The cost was paid from a fund raised by the city of Mt. Sterling.

Considerable difficulty was experienced to secure stone in sufficient quantities to enable the work to be pushed. For that reason the expense was somewhat greater than would have been the case if stone could have been secured as fast as it could have been handled.

Four sizes of limestone were used at Mt. Sterling, viz: 3", mixed; 1½" to 2½"; ½" to ¼" chips and screenings ¼" down. The lower course of stone of mixed sizes was spread according to the accompanying cross-section, thoroughly rolled, filled with screenings and water bound.



WEST CROSS STREET, MT. STERLING

Figure 3.

Upon this bonded lower course, 4 inches of stone of mixed sizes was spread and thoroughly rolled. On those sections of the road where the stone was of such size as to require it, this course was filled with chips. On those sections where the stone was smaller and rolled down to a surface that was tight enough to prevent tar from penetrating more than 1½ inches to 2 inches, no chips were used.

Tarvia X was applied with hand sprinkling cans at the rate of two gallons per square yard to this prepared surface. The tar was covered while hot with chips, which were swept until a uniform distribution was obtained. The surface was then thoroughly rolled and covered lightly with screenings, sprinkled with water and rerolled. It was opened for traffic after forty-eight hours. The atmospheric temperature during tarring was 70° to 90° F., the temperature of tar 200° to 210° F.

Length of road	2,020 feet
Width of macadam	30 feet
Macadam laid	6,733 square yards
Stone in road	2,650 cubic yards
Stone hauled from cars	2,650 cubic yards
Average haul of stone	¼ mile
Surface treated with bituminous binder	6,733 square yards
Amount of binder used (Tarvia X)	13,470 gallons
Average haul of tank wagon	¼ mile
Rate of pay	men, 15c; man and team, 30c per hour
Spreading binder	men, 20c per hour

COST OF LABOR AND SUPPLIES.

Superintendence	$ 98 40
Excavation	282 65
Shaping road bed	122 25
Unloading stone from cars	260 80
Hauling stone	472 85
Spreading stone	187 05
Trimming shoulders and side roads	76 20
Rolling and sprinkling	115 00
Miscellaneous labor	9 30
Coal, oil and supplies	42 35
Heating bituminous binder	61 50

Hauling and spreading bituminous binder	$ 43 25
Cost of bituminous binder, 6½c F. O. B.	875 55
Freight on bituminous binder	199 26
Cost of stone delivered at Mt. Sterling	2,650 00
Total	$5,496 41

COST PER CUBIC YARD FOR PLACING STONE.

Unloading stone from cars	$0.098
Hauling stone	.178
Spreading stone	.071
Rolling and sprinkling	.043
Watchman and miscellaneous labor	.004
Coal, oil and supplies	.016
Total	$0.410

COST PER SQUARE YARD FINISHED MACADAM.

Superintendence	$0.013
Excavation	.042
Shaping road bed	.018
Trimming shoulders and side road	.011
Placing stone	.162
Applying bituminous binder	.015
Cost of bituminous binder F. O. B.	.133
Freight on bituminous binder	.029
Cost of stone delivered	.393
Total	$0.816

FLOSSMOOR.

Homewood-Floosmoor Road, Rich Township, Cook County.

The Floosmoor road is a north and south road passing just east of the Illinois Central station at Floosmoor and is a part of the main road between Homewood and Matteson. Inasmuch as there are several golf club grounds in this vicinity and a number of summer residences, the road is subjected to considerable pleasure driving. For that reason it was decided to build a macadam road treated with tar, particularly because it would be called upon to withstand a considerable amount of automobile traffic. The soil on which the road was constructed is a black loam and the country is only slightly rolling, so that there are no hills. The length of the road is 5,300 feet and the width 12 feet.

Stone for the improvement was furnished from the penitentiary at Joliet. The expense of hauling and placing the stone and the freight was paid by the township commissioners of Rich township. The expense of treating the road with a tar binder was paid from a fund raised among the people living along the road and by the State Highway Commission. The tar used was Barrett's Tarvia X.

Four sizes of crushed limestone were used on the Floosmoor road, viz: 3", 2", and chips from ½" to ¼" with a small amount of dust mixed with them, and screenings from ½" down. The 2-inch stone was used on the lower course, being spread 6 inches thick, rolled, filled

with screenings and water bound. The 3-inch stone was spread 4 inches thick on the bonded lower course, rolled thoroughly and the interstices filled with chips. This course was brushed to insure that no chips remained on top of the stone. Care was taken to have this top layer well choked with chips to prevent the bituminous binder from penetrating more than 1½ to 2 inches.

On separate sections of the road, three distinct methods of applying the bituminous binder were used as follows:

First—An application of one gallon per square yard, followed by an application of one-half gallon per square yard. Upon the surface prepared as previously described, one gallon to the square yard of Tarvia X was spread by means of hand sprinkling cans. The hot tar was covered with chips and swept until the entire surface was covered uniformly with a layer of the chips. It was then rolled twice over. A second application of one-half gallon to the square yard of Tarvia X was then made. Because of the difficulty of spreading such a small amount by hand, the surface was not uniformly covered but had a streaked appearance on account of the tar coming from the cans in broad ribbons which did not completely cover the surface. This spreading of the tar was covered lightly with chips and opened to traffic after forty-eight hours.

Second—An application of one gallon to a square yard of Tarvia X followed by a second application of one gallon to a square yard.

Upon the prepared surface, one gallon per square yard of Tarvia X was distributed with hand sprinkling cans. The tar was covered with chips, swept until a uniform surface was obtained and rolled thoroughly. A second application of one gallon of tar to a square yard was then made and covered with one-quarter inch of chips, thoroughly rolled and opened for traffic after forty-eight hours.

Third—A single application of one and one-half gallons of Tarvia X per square yard.

Upon the prepared surface, one and one-half gallons of Tarvia X was spread with hand sprinkling cans. This was covered with a one-quarter-inch layer of chips and rolled thoroughly. It was then given a light covering of screenings and opened to traffic after forty-eight hours.

Atmospheric temperature during tarring, varied from 55° to 65°F.

Tar applied at a temperature of 200°F.

Length of road	5,300 feet
Width of macadam	12 feet
Macadam laid	7,070 square yards
Stone in road	2,700 cubic yards
Stone hauled from cars	2,000 cubic yards
Stone hauled from storage	700 cubic yards
Average haul of stone	⅝ mile
Surface treated with bituminous binder	6,130 square yards
Bituminous binder used	10,000 gallons
Average haul of tank wagon	1¼ mile

Rate of pay....men, 20c; teams, 50c pr hr; spreading binder, men 27½ pr hr

Naperville Experimental road, DuPage County. Old gravel road, loosened and surface made with asphaltic oil. Built, 1908, surface work, 1909. Photographed, August, 1910. (Section 9.)

COST OF LABOR AND SUPPLIES.

Superintendence	$ 155 00
Excavation	25 00
Shaping road bed	58 00
Unloading stone from cars	215 75
Hauling stone, including reloading	761 60
Spreading stone	248 30
Trimming shoulders and side roads	176 00
Rolling and sprinkling	136 50
Watchman and miscellaneous labor	182 30
Coal, oil and supplies	85 00
Heating bituminous binder	65 00
Hauling and spreading bituminous binder	147 85
Cost of 10,000 gallons Tarvia X @ 6½c, F. O. B.	650 00
Freight on Tarvia	59 00
Freight on stone @ 50c per ton	1,840 32
Total	$4,805 62

COST PER CUBIC YARD FOR PLACING STONE.

Unloading stone from cars	$0.080
Hauling stone, including reloading	.282
Spreading stone	.092
Rolling and sprinkling	.051
Watchman and miscellaneous labor	.068
Coal, oil and supplies	.032
Total	$0.605

COST PER GALLON FOR APPLYING BINDER.

Heating	$0.0065
Hauling	.0086
Spreading	.0062
Total	$0.0213

COST PER SQUARE YARD FINISHED MACADAM.

Superintendence	$0.022
Excavation	.003
Shaping road bed	.008
Trimming shoulders and side roads	.025
Placing stone	.230
Applying bituminous binder	.030
Cost of bituminous binder	.092
Freight on bituminous binder	.008
Freight on stone	.260
Total	$0.678

SYCAMORE.

Geneva and Claire Roads in Sycamore Township, DeKalb Co.

This is a road leading westward from Sycamore to Wilkinson and Claire. The improvement began at the end of the pavement near the city limits of Sycamore and extended for a distance of 4,900 feet. The road was macadamized 12 feet wide. The road was nearly level, requir-

ing only a small amount of excavation to obtain a satisfactory grade. The soil is a light black loam, and the road had some years previously been covered with gravel, making an excellent foundation for a macadam road. Stone for the improvement was furnished from the penitentiary at Joliet and was shipped and unloaded during the winter. A part of the stone was hauled to a storage pile at about the halfway point on the road. Instead of using a bonding gravel for the surface of the macadam, a good quality of bonding screenings was purchased and used for the surface dressing. The expense of the work was to be met from a special tax fund, which necessitated that the work be done by contract. The contract was let on a basis of actual cost plus a fixed sum, and the items given in the cost table for this job represent actual cost to the contractor. When this work was completed, the commission was requested to macadamize a short stretch on the Geneva road between the Great Western tracks and the bridge across the drainage ditch. Of this construction, 340 feet is 12 feet wide and 550 feet is 16 feet wide. The work is partly in the city of Sycamore and partly in the township and connects the city streets with a good gravel road in the township. The costs of the two roads are given in the following tables.

CLAIRE ROAD.

Length of road	4,900 feet
Width of macadam	12 feet
Macadam laid	6,533 square yards
Stone in road	2,100 cubic yards
Stone hauled from storage	2,100 cubic yards
Average haul of stone	⅜ mile
Rate of pay	men, 22 2/9c; man and team, 50c per hour

COST OF LABOR AND SUPPLIES.

Superintendence	$ 86 50
Excavation	81 50
Shaping road bed	65 00
Unloading stone from cars	776 27
Hauling stone, including reloading	737 00
Spreading stone	220 50
Trimming shoulders and side roads	43 00
Rolling and sprinkling	50 00
Watchman and miscellaneous labor	40 00
Coal, oil and supplies	67 14
Bonding screenings	344 63
Freight on stone	1,300 16
Total	$3,811 70

COST PER CUBIC YARD FOR PLACING STONE.

Unloading stone from cars and hauling to storage	$0.370
Hauling stone	.350
Spreading stone	.104
Rolling and sprinkling	.024
Watchman and miscellaneous labor	.019
Coal, oil and supplies	.032
Total	$0.899

COST PER SQUARE YARD FINISHED MACADAM.

Superintendence	$0.0132
Excavation	.0125
Shaping road bed	.0100
Trimming shoulders and side road	.0067
Placing stone	.2900
Bonding screenings delivered	.0570
Freight on stone	.1970
Total	$0.5864

GENEVA ROAD.

Length of road	915 feet
Width of macadam	340 feet, 12 feet; 575 feet, 16 feet
Macadam laid	1,476 square yards
Stone in road	465 cubic yards
Stone hauled from storage	465 cubic yards
Average haul of stone	¾ mile
Rate of pay	men, 22c and 25c; man and team, 45c per hour

COST OF LABOR AND SUPPLIES.

Superintendence	$ 42 00
Shaping road bed	37 52
Loading stone from storage	90 45
Hauling stone	204 75
Spreading stone	35 30
Rolling and sprinkling	24 50
Watchman and miscellaneous labor	25 00
Coal, oil and supplies	9 24
Crushed stone delivered at siding	465 00
Total	$933 76

COST PER CUBIC YARD FOR PLACING STONE.

Loading stone	$0.194
Hauling stone	.440
Spreading stone	.075
Rolling and sprinkling	.053
Watchman and miscellaneous labor	.054
Coal, oil and supplies	.020
Total	$0.836

COST PER SQUARE YARD FINISHED MACADAM.

Superintendence	$0.0285
Shaping road bed	.0254
Placing stone	.2630
Cost of crushed stone	.3150
Total	$0.6319

MORRIS.

South Morris Road in Wauponsee Township, Grundy Co.

This road is on a fill in the Illinois river bottoms, and a concrete wall was built on the down stream side of the road to a height that would insure a layer of dead water on the macadam when the river overflows. The macadam is 3,900 feet long and 16 feet wide.

Stone was furnished from the penitentiary at Joliet, and a part of it was shipped in and unloaded during the winter. The cost of the improvement, including freight on the stone and the cost of hauling and placing the stone, was paid from a fund raised by special tax. The surface of the road was finished with a good quality of binding gravel.

The fill had washed badly and had to be raised and widened which explains the items in the cost table of $1,193.67 for excavation and $155.45 for material. A ridge was left along the earth shoulder opposite the wall to prevent the storm water from washing gulleys in the shoulder.

A second section of the South Morris road which had always been very sandy was improved in the same general manner as the first section. The macadam is 16 feet wide and 650 feet long.

NORTH SECTION.

Length of road	3.900 feet
Filling	650 cubic yards
Width of macadam	16 feet
Macadam laid	6,934 square yards
Stone in road	2,300 cubic yards
Stone hauled from cars	979 cubic yards
Stone hauled from storage	1,621 cubic yards
Average haul of stone	¾ mile
Rate of pay	men, 22½c; man and team, 33½c per hour

COST OF LABOR AND SUPPLIES.

Superintendence	$ 229 50
Shaping road bed	63 00
Unloading stone from cars	230 00
Hauling stone, including rehandling	773 45
Spreading stone	198 01
Trimming shoulders and side roads	59 00
Rolling and sprinkling	125 60
Watchman and miscellaneous labor	107 50
Coal, oil and supplies	46 82
Excavation (filling) labor	1,193 67
Material for fill	155 45
Gravel binder	10 00
Freight on stone	1.865 55
Concrete protecting wall 2,900 feet long	2,250 00
Total	$7,307 55

COST PER CUBIC YARD FOR PLACING STONE.

Unloading stone from cars	$0.1000
Hauling stone, including rehandling	.3370
Spreading stone	.0865
Rolling and sprinkling	.0545
Watchman and miscellaneous labor	.0530
Coal, oil and supplies	.0200
Total	$0.6510

COST PER SQUARE YARD FINISHED MACADAM.

Superintendence	$0.033
Shaping road bed	.009
Trimming shoulders and side roads	.008
Placing stone	.214
Gravel binder	.002
Freight on stone	.270
Total	$0.536

SOUTH SECTION.

Length of road	650 feet
Width of macadam	16 feet
Macadam laid	1,600 square yards
Stone in road	225 cubic yards
Stone hauled from storage	104 cubic yards
Average haul of stone	1½ miles
Rate of pay	men, 22½c; man and team, 44½c per hour

COST OF LABOR AND SUPPLIES.

Superintendence	$ 50 50
Excavation	173 00
Shaping road bed	1 65
Unloading stone from cars	11 00
Hauling stone, including rehandling	109 00
Spreading stone	12 00
Rolling and sprinkling	14 50
Watchman and miscellaneous labor	8 00
Coal, oil and supplies	13 50
Filling material	26 70
Freight on stone	123 31
Total	$543 16

COST PER CUBIC YARD FOR PLACING STONE.

Unloading stone from cars	$0.105
Hauling stone, including rehandling	.485
Spreading stone	.053
Rolling and sprinkling	.065
Watchman and miscellaneous labor	.004
Coal, oil and supplies	.060
Total	$0.772

COST PER SQUARE YARD FINISHED MACADAM.

Superintendence	$0.032
Excavation	.107
Shaping road bed	.001
Placing stone	.105
Filling material	.017
Freight on stone	.077
Total	$0.339

GALVA.

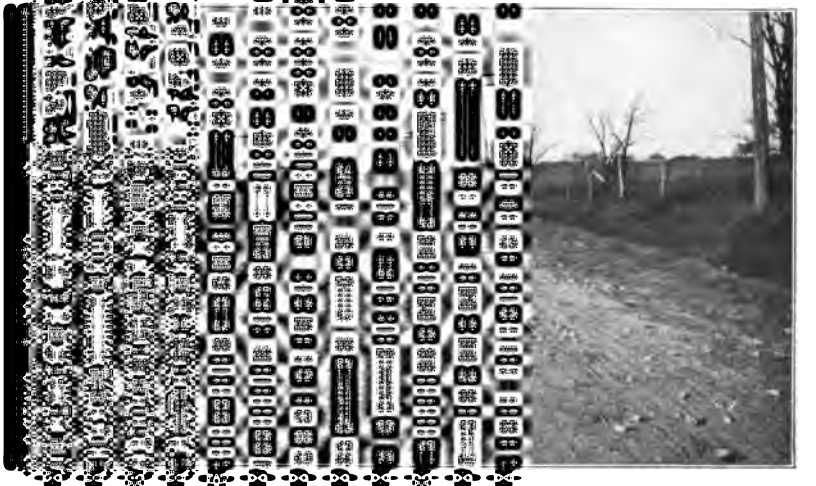
Cemetery Road in Galva Township, Henry County.

This road extends in an easterly direction from Galva, a distance of a little over a mile to the top of what is known as the Cemetery hill. The road began at the Rock Island Railroad track in Galva and was built on the city street and out into the township, a total length of 7,155 feet. The part of the road in the city, 1,350 feet in length was made 15 feet wide; the remainder was 12 feet wide. The soil on which this road was constructed is a black loam, and the road is hilly, there being several grades of 3 per cent and 4 per cent. Several substantial concrete culverts were constructed to take care of the drainage. Money for paying the freight on the stone and for paying a part of the labor was furnished by the Commercial Club of Galva. A large amount of labor, both men and teams, was donated. Stone was furnished from the crusher at Joliet, and the road was surfaced with a good bonding gravel.

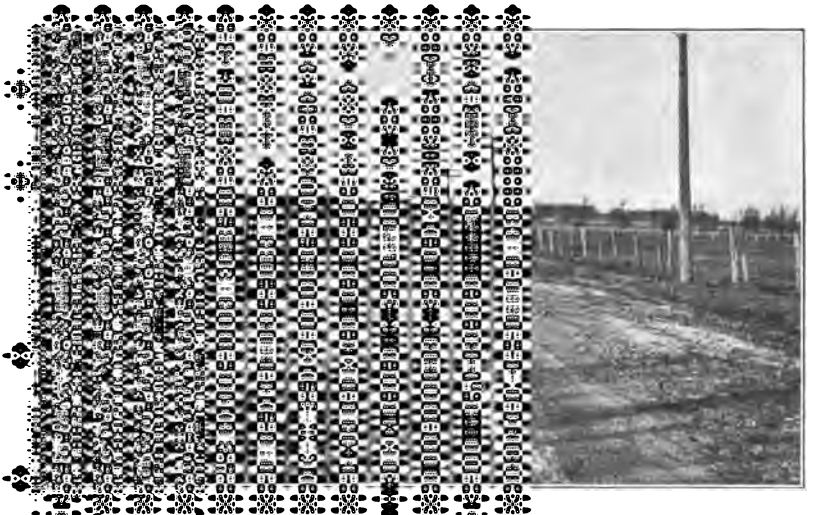
Length of road	7,155 feet
Width of macadam	1,350 feet, 15 feet; 5,805 feet, 12 feet
Macadam laid	10,200 square yards
Stone in road	3,450 cubic yards
Stone hauled direct from cars	1,610 cubic yards
Stone hauled from storage	1,840 cubic yards
Average haul of stone	¾ mile
Rate of pay	men, 17½c; team, 35c per hour

COST OF LABOR AND SUPPLIES.

Superintendence	$ 66 00
Excavation	205 30
Shaping road bed	95 80
Unloading stone from cars	459 85
Hauling stone, including rehandling	1,107 45
Spreading stone	410 80
Trimming shoulders and side roads	149 25
Rolling and sprinkling	111.25
Coal, oil and supplies	53 75
Gravel binder delivered	286 50
Freight on stone	3,409 00
Total	$6,354 95



penitentiary limestone. Note
er portion of same road, to
Built, 1909. Photographed,



penitentiary limestone, on
adds the necessary binding
e. Road built, 1909. Photo-

COST PER CUBIC YARD FOR PLACING STONE.

Unloading stone from cars	$0.133
Hauling stone, including reloading	.322
Spreading stone	.119
Rolling and sprinkling	.032
Coal, oil and supplies	.016
Total	$0.622

COST PER SQUARE YARD FINISHED MACADAM.

Superintendence	$0.007
Excavation	.020
Shaping road bed	.009
Trimming shoulders and side roads	.015
Placing stone	.210
Gravel binder	.028
Freight on stone	.334
Total	$0.623

WATSEKA.

Cemetery Road in Middleport Township, Iroquois County.

This improvement is on what is known as the Cemetery road out of Watseka, beginning at the township line and extending toward the cemetery a distance of 6,000 feet. The soil is a sandy clay underlaid with patches of quick sand, which made it particularly difficult to get a firm roadbed. The macadam was built 12 feet wide. Stone was furnished from the penitentiary at Joliet, and was shipped and unloaded during the spring. The freight and cost of hauling and placing the stone was paid for by the township commissioners from the regular township funds. The road was finished with a bonding gravel, which, however, did not prove to be the proper quality. The commissioners were advised to cover the surface with sandy loam to prevent raveling on the surface. The cuts on the opposite page show the effect of such a surface covering.

Length of road	6,000 feet
Width of macadam	12 feet
Macadam laid	8,000 square yards
Stone in road	2,600 cubic yards
Stone hauled from storage	2,600 cubic yards
Average haul of stone	1½ miles
Rate of pay	men, 15c; man and team, 35c per hour

COST OF LABOR AND SUPPLIES.

Superintendence	$ 103 20
Excavation	39 54
Shaping road bed	24 68
Unloading stone from cars	290 00
Hauling stone, including rehandling	898 72
Spreading stone	153 63
Trimming shoulders and side roads	8 12
Rolling and sprinkling	85 95

Watchman and miscellaneous labor	$ 188 42
Coal, oil and supplies	65 00
Gravel binder	127 92
Freight on stone	2,100 00
Total	$4,085 18

COST PER CUBIC YARD FOR PLACING STONE.

Unloading stone from cars	$0.112
Hauling stone, including rehandling	.345
Spreading stone	.059
Rolling and sprinkling	.033
Watchman and miscellaneous labor	.072
Coal, oil and supplies	.025
Total	$0.646

COST PER SQUARE YARD FINISHED MACADAM.

Superintendence	$0.013
Excavation	.005
Shaping road bed	.003
Trimming shoulders and side road	.0001
Placing stone	.2102
Gravel binder	.016
Freight on stone	.262
Total	$0.5093

JERSEYVILLE.

Fieldon Road, English Township, Jersey County.

The English township experimental macadam road is a section of the road between Jerseyville and Fieldon beginning at the township line between Jersey and English townships and extending westward a distance of 6,300 feet. The country is somewhat rolling but the road to be improved was poorly drained. The soil is light, brown loam and in sections of the road corduroy had been used to make it passable in wet weather. It presented one of the worst conditions that is encountered in the State for macadam construction. The macadam was constructed 12 feet wide. Inasmuch as it is three miles from the railway siding to the nearer end of the road, it was decided to use a hauling engine and special, bottom dump wagons for hauling the stone. On account of the nature of the road over which the hauling was done, and the frequent rains, it became necessary to supplement the work of the hauling engine with teams.

Stone for the improvement was furnished from the penitentiary at Chester. On account of wet weather which made hauling with an engine very irregular, the stone could not be hauled as fast as it was shipped in and twenty-four cars were unloaded on the ground and then rehauled. Before they could be unloaded, $330.00 demurrage had accrued.

The freight on the stone and the cost of hauling and placing was paid from a fund raised by subscription.

Fieldon Road, Jersey Township, Jersey County.

The Jersey township experimental road is a section of the road between Jerseyville and Fieldon, beginning at the township line between Jersey and English townships and extending eastward to connect with an old macadam road out of Jerseyville. The total length is 5,055 feet. The soil and drainage conditions are similar to those on the English township road. There are two hills having a grade of about 2 per cent on the road. On these hills were seepy places and 700 feet of underdrainage was laid to remove the underground water. Stone for the improvement was furnished from the penitentiary at Chester and also from the commercial quarries at Alton. The macadam was made 12 feet wide and 8 inches thick, finished. The work was done under a cost plus a percentage contract, the expense being met by a fund raised by a special tax levy.

Three small concrete culverts were built at a cost of $190.40, on the English township section of the road. On the Jersey township section, a 10-foot concrete girder bridge is to be built on the stone abutments of an old wooden floor bridge.

Length of road	11,455 feet
Width of macadam	12 feet
Macadam laid	15,273 square yards
Stone in road	4,457 cubic yards
Stone hauled from storage	1,650 cubic yards
Stone hauled from cars	1,825 cubic yards
Stone hauled by engine	2,032 cubic yards
Stone hauled by teams	2,425 cubic yards
Rate of pay	men, 20c per hour; teams, 35c per hour

COST OF LABOR AND SUPPLIES.

Superintendence	$ 590 55
Excavation	458 48
Shaping road bed	236 15
Unloading stone from cars to trucks	311 07
Unloading stone from cars to storage	188 00
Hauling stone with engine, including supplies for engine and loading trucks from storage	1,156 00
Hauling stone by wagon, including loading wagons	1,738 28
Spreading stone	553 68
Trimming shoulders and side roads	129 36
Rolling and sprinkling	349 60
Watchman and miscellaneous labor	371 33
Coal, oil and supplies for roller	125 00
Freight, car service and cost of six cars of stone	3,234 90
Total	$9,442 33

COST PER CUBIC YARD FOR PLACING STONE WITH ENGINE. AVERAGE HAUL THREE MILES.

Unloading stone from cars to trucks	$0.153
Unloading stone from cars to storage	.113
Hauling stone with engine, including supplies for engine and reloading stone	.570
Spreading stone	.125

Rolling and sprinkling	$0.080
Watchman and miscellaneous labor	.083
Coal, oil and supplies for roller	.029
Total	$1.153

COST PER CUBIC YARD FOR PLACING STONE WITH TEAMS.
AVERAGE HAUL ONE AND ONE-HALF MILES.

Unloading stone from cars to storage	$0.113
Hauling stone, including loading wagons	.718
Spreading stone	.125
Rolling and sprinkling	.080
Watchman and miscellaneous labor	.083
Coal, oil and supplies for roller	.029
Total	$1.148

COST PER SQUARE YARD FINISHED MACADAM.
7438 SQUARE YARDS PLACED WITH ENGINE.

Superintendence	$0.039
Excavation	.03
Shaping road bed	.015
Trimming shoulders and side roads	.009
Placing stone	.285
Freight and car service on stone	.212
Total	$0.590

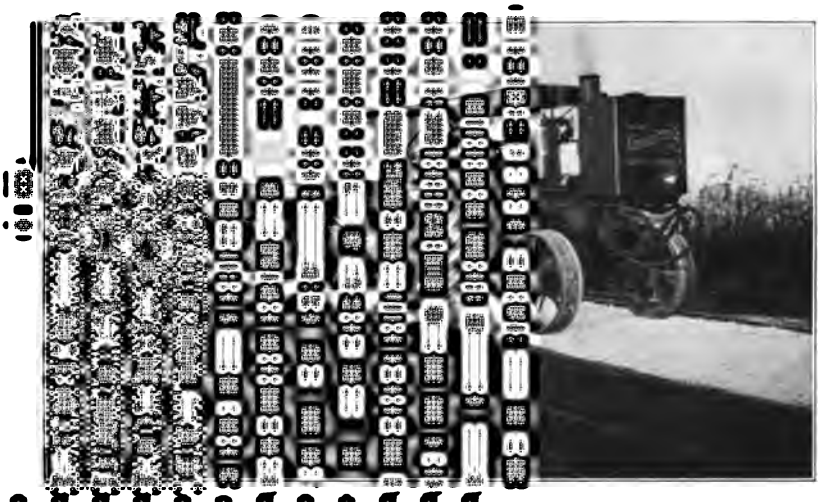
COST PER SQUARE YARD FINISHED MACADAM.
7,830 SQUARE YARDS PLACED BY TEAMS.

Superintendence	$0.039
Excavation	.03
Shaping road bed	.015
Trimming shoulders and side roads	.009
Placing stone	.345
Freight and car service on stone	.212
Total	$0.650

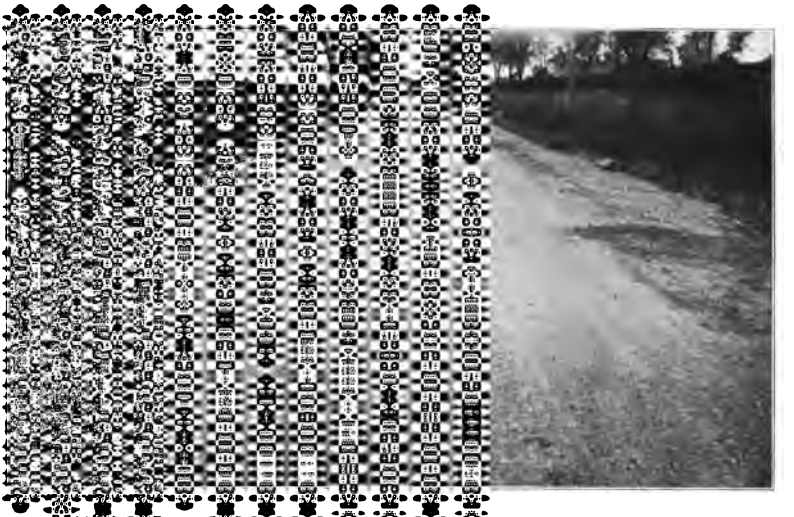
ELBURN.

Lily Lake Road, Blackburn Township, Kane County.

At Elburn the experimental macadam road built in 1907 was resurfaced and treated with Tarvia X. The road was somewhat rutted and had ravelled in places. It was spiked up and harrowed to let down all fine material. Enough 2-inch stone was added to bring the road to the proper section and then it was thoroughly rolled. On account of the solid foundation, the stone spalled sufficiently under the roller to give a surface that was tight enough for applying tar without being choked with chips. Upon this surface, three 1¾ gallons to square yard of Tarvia X was spread with hand distributing cans. The tar was covered while hot with chips and rolled. It was then covered lightly with screenings and opened for traffic. The atmospheric temperature during tarring was 35° to 45°F, the temperature of tar, 180° to 200°F.



Capacity, each wagon, 7 yards.



County, after improvement.
shown above.

Length of resurfaced road	4,000 feet
Width of treated road	10 feet
Surface treated	4,400 square yards
Binder used	8,000 gallons
Average haul of stone and tar	1¾ miles
Cost of labor	men, 20c per hour; teams, 40c per hour

COST PER SQUARE YARD.

Labor	$0.117
Freight on stone	.006
Freight on tar	.011
Tar	.118
Miscellaneous supplies	.016
Total cost per square yard	$0.268

TOTAL COST.

Labor	$ 513 93
Miscellaneous supplies	71 07
Freight on stone chips	25 39
Freight on tar	48 52
8,000 gallons tar @ 6½ cents F. O. B. factory	520 00
Total	$1,178 91

GRANT PARK.

Bailey's Lane, Yellowhead Township, Kankakee County.

Bailey's lane leads eastward from Grant Park and intersects the Chicago-Vincennes road about half a mile from the village limits. The part of the road which was macadamized was that between the city limits and the Chicago-Vincennes road, the total length improved being 3,300 feet. The road leads through the bottoms adjacent to a small creek, and considerable grading was necessary to take care of the water, of which a large amount collects during the spring rains. This grading was done by the township commissioners before the experimental road was started, but the cost is included in the cost table for this road. The soil is a black, sticky loam. The macadam was made 12 feet wide and was treated with Tarvia X.

The freight and the cost of hauling and placing the stone and spreading the bituminous binder was paid from the township funds. Stone was furnished from the penitentiary at Joliet. The cost of heating the tar, which amounts to about $30.00, was donated by the Curtis Brick Company, whose plant furnished the facilities for heating the material.

Four sizes of crushed limestone were used on the Grant Park road, viz: 3", 2", chips from ½" to ¼" with a small amount of dust mixed with them, and screenings from ½" down.

It was not decided to use a bituminous binder on the Bailey Lane until after the stone had been placed. For that reason, the stone had been spread in two 5-inch layers, the lower of 2-inch stone and the upper of 3-inch stone. The upper course of stone was rolled and filled with limestone chips which were swept into the interstices. The surface was

then covered with two gallons to square yard of Tarvia X which was spread with hand sprinkling cans. The tar was covered with one-quarter inch of limestone chips and rolled once over. The surface was then covered lightly with screenings and opened for traffic after twenty-four hours. The atmospheric temperature during tarring was 30° to 40°F., the temperature of tar 200° to 210°F.

Length of road	3,300 feet
Width of macadam	12 feet
Macadam laid	4,400 square yards
Average haul of stone	½ mile
Stone in road	1,450 cubic yards
Stone hauled from storage	1,450 cubic yards
Surface treated with bituminous binder	3,826 square yards
Amount binder used (Tarvia X)	8,000 gallons
Average haul of tank wagon	½ mile
Rate of pay	men, 20c per hour; teams, 40c per hour

COST OF LABOR AND SUPPLIES.

Superintendence	$ 55 00
Excavation	100 00
Shaping road bed	56 55
Unloading stone from cars	145 00
Hauling stone (including reloading)	574 00
Spreading stone	133 50
Trimming shoulders and side roads	27 90
Rolling and sprinkling	90 60
Watchman and miscellaneous labor	94 45
Coal, oil and miscellaneous supplies	58 30
Heating bituminous binder	30 00
Hauling and spreading bituminous binder	36 80
Cost of bituminous binder @ 6½ F. O. B.	520 00
Freight on bituminous binder	57 00
Freight on stone	900 00
Total	$2,889 10

COST PER CUBIC YARD FOR PLACING STONE.

Unloading stone from cars	$0.100
Hauling stone (including reloading)	.400
Spreading stone	.092
Rolling and sprinkling	.063
Watchman and miscellaneous labor	.065
Coal, oil and supplies	.041
Total	$0.761

COST PER GALLON FOR APPLYING BITUMINOUS BINDER.

Heating	$0.0037
Hauling and spreading	.0046
Total	$0.0083

COST PER SQUARE YARD FINISHED MACADAM.

Superintendence	$0.012
Excavation	.023
Shaping road bed	.013
Trimming shoulders and side roads	.007

Placing stone	$0.251
Applying binder	.015
Cost of bituminous binder	.120
Freight on bituminous binder	.013
Freight on stone	.205
Total	$0.659

GRANT PARK.

North Road, Yellowhead Township, Kankakee County.

This road begins on R. R. street in Grant Park, extends northward along this street, thence westward a short distance, and northward again into the township, the total length being 3,510 feet. The country is rolling, and, although there are no grades of more than two per cent, a considerable amount of work was necessary in order to establish a satisfactory grade. The grading was done by the township commissioners before the experimental work began, but the cost is included in the cost table for the experimental work. The soil is a black loam. Stone for the improvement was furnished from the penitentiary at Joliet for a 12-foot macadam. The expense connected with the work, including the freight on the stone and the hauling and placing of the same upon the road was paid from the township funds.

Length of road	3,510 feet
Width of macadam	12 feet
Macadam laid	4,680 square yards
Stone in road	1,520 cubic yards
Stone hauled from cars	378 cubic yards
Stone hauled from storage	1,142 cubic yards
Average haul of stone	½ mile
Rate of pay	men, 20c; man and team, 40c per hour

COST OF LABOR AND SUPPLIES.

Superintendence	$ 87 50
Excavation	100 00
Shaping road bed	51 60
Unloading stone from cars	178 04
Hauling stone, including reloading	429 80
Spreading stone	84 71
Trimming shoulders and side roads	32 60
Rolling and sprinkling	52 90
Watchman and miscellaneous labor	34 40
Coal, oil and supplies	34 16
Freight on stone	912 00
Total	$1,997 71

COST PER CUBIC YARD FOR PLACING STONE.

Unloading stone from cars	$0.117
Hauling stone	.282
Spreading stone	.056
Rolling and sprinkling	.035
Watchman and miscellaneous labor	.023
Coal, oil and supplies	.022
Total	$0.535

COST PER SQUARE YARD FINISHED MACADAM.

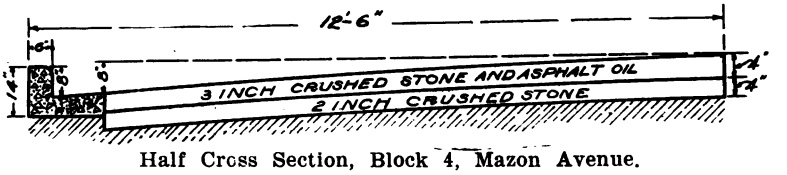
Superintendence	$0.0186
Excavation	.0214
Shaping road bed	.0110
Trimming shoulders and side road	.0070
Placing stone	.1740
Freight on stone	.1950
Total	$0.4270

CITY OF DWIGHT.

Mazon Avenue, City of Dwight, Livingston County.

The Mazon avenue experimental work is an extension of Mazon avenue road and was constructed as an experimental bituminous macadam.

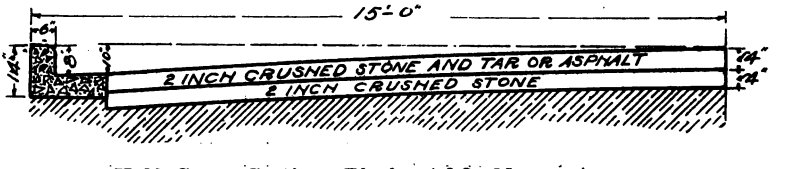
For convenience, the four blocks paved are referred to as blocks 1, 2, 3 and 4, block 1 being the block adjoining the brick pavement at the east end and block 2, 3 and 4 following in order westward from block 1.



Half Cross Section, Block 4, Mazon Avenue.

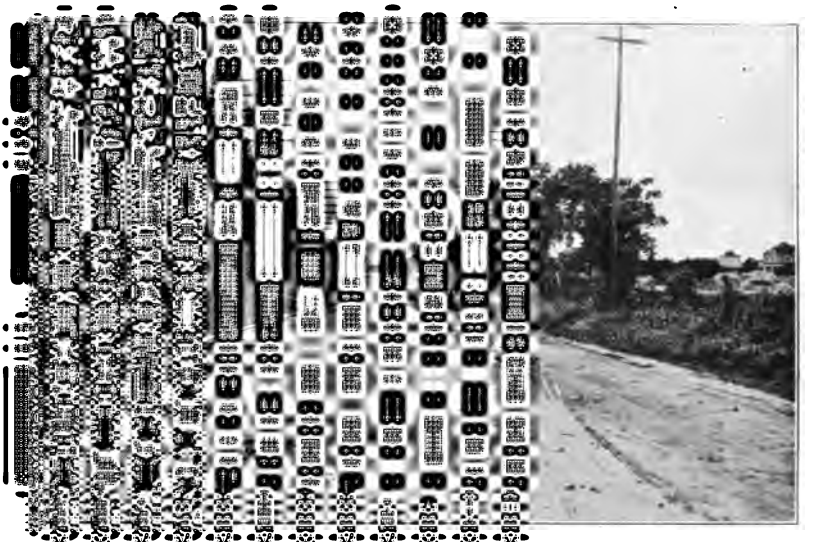
Figure 4.

Three sizes of limestone were used at Dwight, viz.: Three inches, 2 inches and screenings from one-quarter-inch down. On blocks 1, 2 and 3, two 5-inch courses of 2-inch stone were spread. On block 3, the lower course was thoroughly rolled before the top course was spread, but on blocks 1 and 2 no rolling was done until both courses had been spread. The spreading was completed late in the fall and work was discontinued until spring at which time these blocks were reshaped and rolled. On account of soft foundation it was impossible to roll thoroughly. No screenings were used before the bituminous binder was distributed. On block 4, the 5-inch lower course of 2-inch stone was spread and rolled, and upon this course 5 inches of 3-inch stone was spread and thoroughly rolled. This work was finished in the fall but was reshaped in the spring, rerolled and the voids partially filled with screenings but leaving a somewhat open surface.

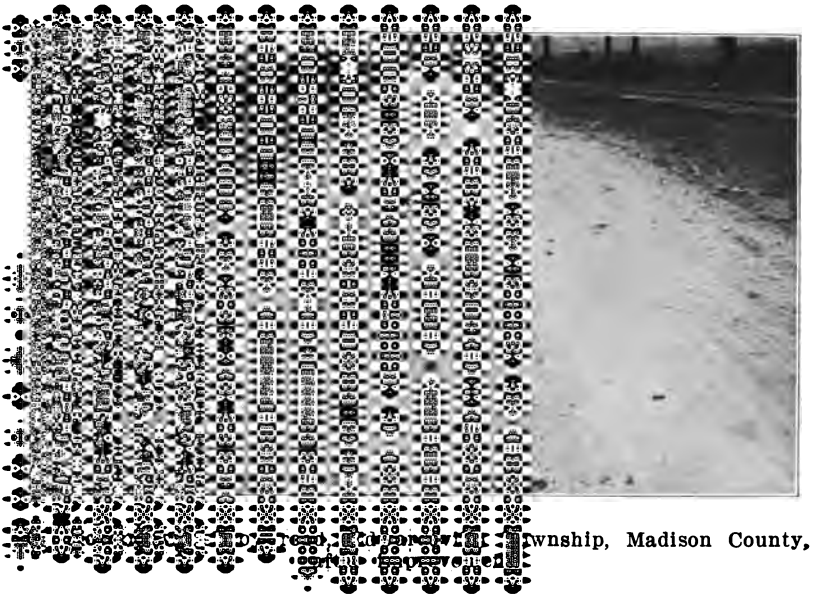


Half Cross Section, Blocks 1-2-3, Mazon Avenue.

Figure 5.



hip, Madison County, after
traveled. Built in 1909.



wnship, Madison County,

Blocks 3 and 4 prepared as outlined above were treated with two gallons to square yard of liquid asphalt, which was spread by means of a special distributing wagon loaned by the oil company. After the asphalt was spread, it was covered with a one-quarter-inch layer of screenings and rolled. After the rolling, the surface was gone over with a stiff broom and a second light layer of screenings was spread and the road opened to traffic.

Blocks 1 and 2, prepared as outlined above were treated with two gallons to a square yard of Tarvia "A" which was spread with the same distributing wagon. After the tar was spread it was covered with a light layer of screenings, broomed and rolled. After being rolled a second light layer of screenings was spread and the road opened for traffic.

With both materials, the distribution was somewhat streaked on account of construction of the spray device on the wagon. The narrow tired wheels on the distributing wagon and the hoofs of the horses drawing the wagon displaced the stone to some extent.

Atmospheric temperature ranged from 30° to 50°F. Temperature of the binders 190° to 210°F.

Length of road	2,900 feet
Width of macadam	22 feet and 27 feet
Macadam laid	8,000 square yards
Stone in road	3,412 cubic yards
Average haul of stone	½ mile
Lineal feet concrete curb and gutter	5,919
Surface treated with bituminous binder	8,000 square yards
Amount of bituminous binder used	16,000 gallons
Average haul of tank wagon	⅜ mile
Rate of pay	men, 20c per hour; teams, 40c per hour

COST OF LABOR AND SUPPLIES.

Superintendence	$ 65 00
Excavation and shaping road bed	540 00
Hauling stone, including loading	1,125 30
Spreading stone	321 20
Rolling and sprinkling	186 00
Watchman and miscellaneous labor	72 10
Coal, oil and supplies	62 20
Cost of 16,000 gallons bituminous binder delivered	800 00
Heating bituminous binder	35 00
Hauling and spreading bituminous binder	50 00
Freight on stone @ 25c per ton	1,292 17
Total	$4,553 97
Cost of curb and gutter and catch basins	2,820 00
Total	$7,373 97

COST PER CUBIC YARD FOR PLACING STONE.

Hauling stone, including unloading from cars	$0.33
Spreading stone	.094
Rolling and sprinkling	.055
Watchman and miscellaneous labor	.021
Coal, oil and supplies	.018
Total	$0.518

COST PER GALLON FOR APPLYING BITUMINOUS BINDER.

Heating	$0.0022
Hauling and spreading	.0034
Total	$0.0054

COST PER SQUARE YARD FINISHED MACADAM.

Superintendence	$0.0081
Excavation and shaping road bed	.0675
Placing stone	.220
Applying bituminous binder	.011
Cost of bituminous binder	.100
Freight on stone	.162
Total	$0.5686

BUSHNELL.

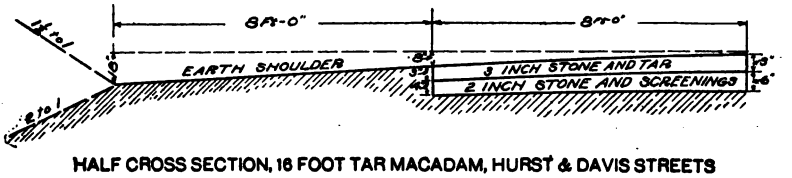
Hurst and Davis Street Roads, Bushnell Township, McDonough County.

Hurst street road begins at the end of the brick pavement on West Hurst street and extends westward along Hurst street and along the Hurst street township road, a total length of 2,840 feet. Beginning at the pavement and extending for a distance of 1,280 feet, the road is 16 feet wide. The remainder of the distance is 12 feet wide.

Davis street road begins at the pavement on Davis street and extends in an easterly direction along Davis street and the Davis street township road, a distance of 2,400 feet. Beginning at the pavement and extending for 1,500 feet, the road is 16 feet wide. The remainder of the road is 12 feet wide.

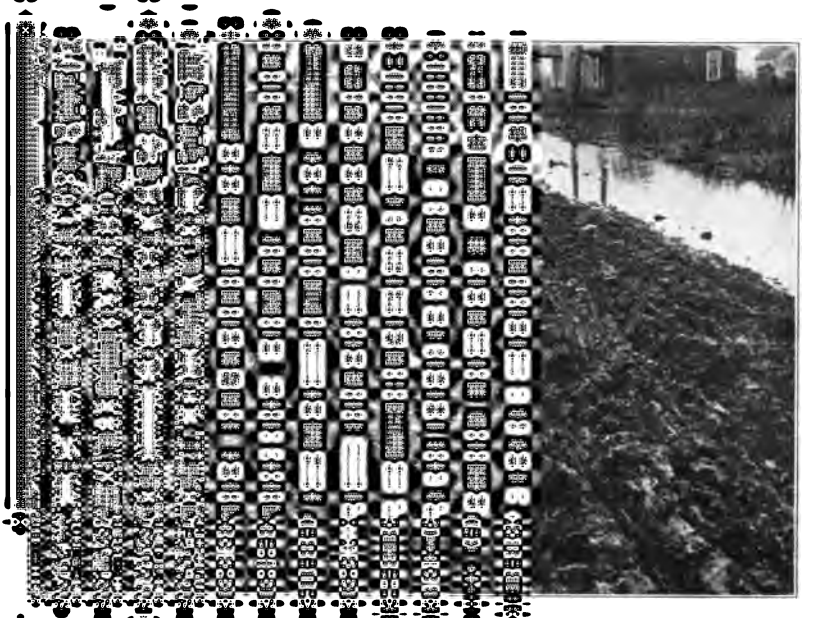
Both of these roads were constructed at the expense of the town of Bushnell for the purpose of promoting the good roads sentiment and demonstrating the practicability of this form of construction on the black soil which is found in that vicinity. Inasmuch as a part of each road was on the city street, the grade was established according to the principles for street work. The part of each road lying outside the city was comparatively level, and no considerable amount of grading was necessary. Stone for the improvement was furnished from the penitentiary at Joliet, the greater part of it being shipped in and unloaded during the spring. The entire cost of the improvement was paid from the city funds. All the work except 400 feet at end of Hurst street was treated with Tarvia X.

Four sizes of limestone were used on the work at Bushnell as follows: Three-inch, 2-inch, half-inch to quarter chips and screenings from half-inch down.

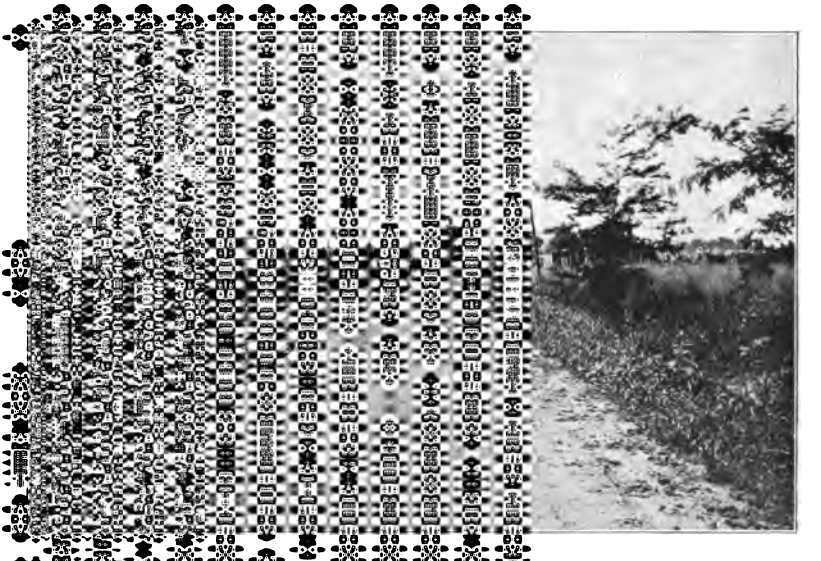


HALF CROSS SECTION, 16 FOOT TAR MACADAM, HURST & DAVIS STREETS

Figure 6.

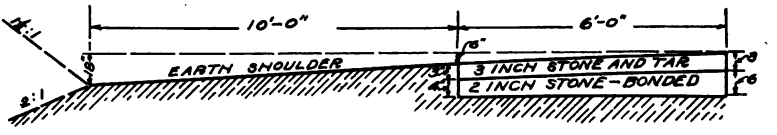


Independence road before



Independence road after im-
built, 1909. Photographed,

The lower course of stone was spread to roll to thickness shown on the cross sections, thoroughly rolled, filled with screenings and water bound. Upon this lower course, 4 inches of 3-inch stone was spread, rolled and filled with chips and brushed to give a clean surface.



HALF CROSS SECTION, 12 FOOT TAR MACADAM, HURST & DAVIS STREETS

Figure 7.

The distinct methods of applying tar were used, one on Davis street road and the other on Hurst street road.

Davis Street.

An application of one and three-quarter gallons to square yard of Tarvia X followed by three-quarter gallons to square yard of same material was made on Davis street.

Upon the prepared surface, 1¾ gallons to a square yard of tar was spread with hand sprinkling cans, covered with a one-quarter-inch layer of chips and rolled. The surface was then gone over with a stiff broom to insure an even distribution of the chips and was rolled again. Upon the surface, three-quarter gallon per square yard of tar was spread in the same manner as before and covered with chips, broomed and rolled and then opened for traffic. On one section of the Davis street road, the method followed was the same as that to be described for Hurst street road.

Hurst Street Road.

A single application of two gallons to a square yard of tar was made on Hurst street.

Upon the prepared surface, two gallons per square yard of tar was spread with hand sprinkling cans. The hot tar was covered with ½-inch of chips and rolled. After rolling, the surface was gone over with a stiff broom to insure a uniform distribution of chips and then re-rolled. The surface was then covered light with screenings and opened for traffic after forty-eight hours.

Atmospheric temperature during tarring was 40° to 70° F, temperature of tar varied from 190° to 210° F.

Length of road	**5,240 feet**
Width of macadam	**2,540 feet, 12 feet; 2,700 feet, 16 feet wide**
Macadam laid	**8,190 square yards**
Stone in road	**2,800 cubic yards**
Stone hauled from cars	**460 cubic yards**
Stone rehandled from storage	**2,100 cubic yards**
Amount of treated road	**7,660 square yards**

Tar used	17,000 gallons
Average haul of stone and tar	½ mile
Rate of pay	men, 19½c; teams, 39c per hour

COST OF LABOR AND SUPPLIES.

Superintendence	$ 182 00
Excavation	283 25
Shaping road bed	93 80
Unloading stone from cars	338 55
Hauling stone, including rehandling	1,019 60
Spreading stone	312 65
Trimming shoulders and side roads	266 90
Rolling and sprinkling	190 95
Watchman and miscellaneous labor	196 55
Coal, oil and supplies	57 80
Heating bituminous binder	80 00
Hauling and spreading binder	127 00
Dressing with chips	106 70
17,000 gallons binder @ 6½c, F. O. B.	1,105 00
Freight on bituminous binder	74 50
Freight on stone	4,323 88
Total	$8,758 13

COST PER CUBIC YARD FOR PLACING STONE.

Unloading from cars	$0.121
Hauling, including rehandling	.364
Spreading stone	.112
Rolling and sprinkling	.067
Watchman and miscellaneous labor	.070
Coal, oil and supplies	.020
Total	$0.754

COST PER GALLON FOR APPLYING BINDER.

Heating	$0.0047
Hauling and spreading	.0076
Total	$0.0123

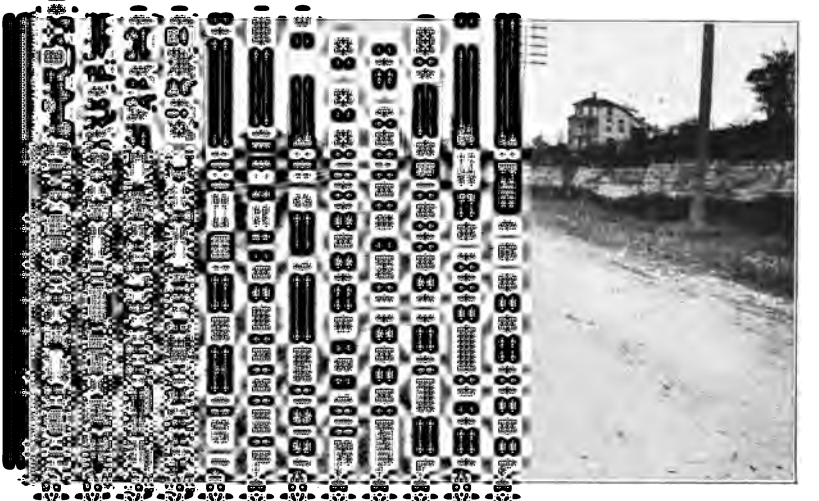
COST FOR LABOR AND SUPPLIES PER SQUARE YARD FINISHED MACADAM.

Superintendence	$0.0220
Excavation	.0345
Shaping road bed	.0115
Trimming shoulders and side roads	.0325
Placing stone	.2600
Applying bituminous binder	.0383
Bituminous binder @ 2.1 gallon square yard	.1350
Freight on stone and bituminous binder	.5290
Total	$1.0628

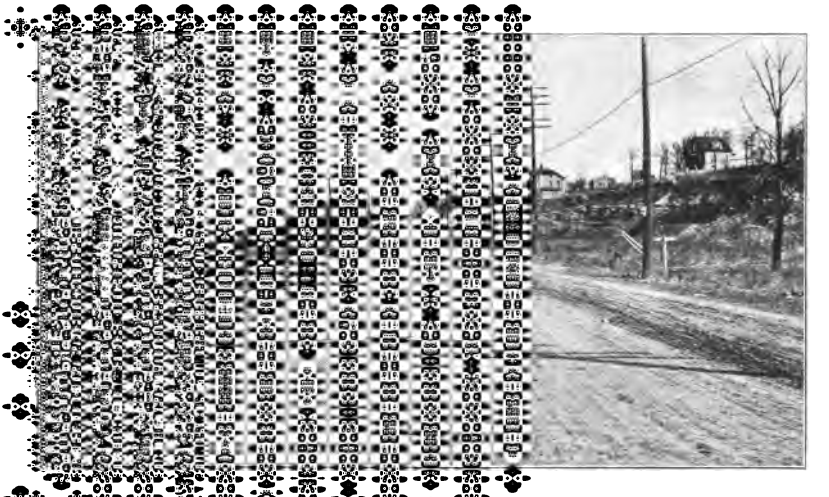
EDWARDSVILLE.

Edwardsville-Troy and West Street Roads, Edwardsville Township, Madison County.

Two separate pieces of work were undertaken at Edwardsville. The macadam on the Troy road begins at the end of the oiled street in the



Lockport road before improvement.



Lockport road after improvement. Built, 1908

Nelson addition and extends for a half mile in an easterly direction. The macadam is 8 inches thick and 12 feet wide and water bound. The West street, St. Louis road begins at the corner of Main and West streets and extends along West street for 1,100 feet, thence along the St. Louis road for a distance of one-half mile. On West street, the macadam is finished with a bituminous binder and has a concrete curb and gutter. From the end of West street the macadam is 12 feet wide, 8 inches thick and is water bound. The cost of the portion of the work inside the city was paid from the city funds and the remainder of the expense was paid from the township funds.

Four sizes of limestone were used on the Edwardsville work, viz.: Three inches, 2 inches, one-half inch to one-quarter inch chips with a small amount of dust mixed with them, and screenings one-half inch down.

The lower course of 2-inch stone was spread to roll to a thickness shown on the cross section and thoroughly rolled, filled with screenings and water bound.

Upon this bonded lower course, 4 inches of 3-inch limestone was spread and thoroughly rolled and filled with chips, the surface being carefully swept. Upon this surface 1¾ gallons per square yard of Tarvia X was spread with hand sprinkling cans. The hot tar was covered lightly with chips, broomed and rolled. Upon this surface three-quarters gallons to a square yard of tar was spread in the same manner as before, covered with a heavy layer of chips and rolled. It was then gone over with a stiff broom, re-rolled and opened to traffic. The atmospheric temperature during tarring was 40° F, the temperature of tar 190° to 200° F.

Length of road	3,900 feet
Width of macadam	2,800 @ 12 feet; 1,100 @ 22 feet
Macadam laid, including intersections	6,475 square yards
Stone in road	2,100 cubic yards
Stone hauled from storage	2,100 cubic yards
Average haul of stone and tank wagon	½ mile
Surface treated with tar	2,740 square yards
Binder used (Tarvia X)	7,000 gallon

Rate of pay..men, 22 2/9c; teams, 50c pr hr; men spreading binder, 25c pr hr

COST OF LABOR AND SUPPLIES.

Superintendence	$ 80 90
Excavation	32 10
Shaping road bed	75 25
Unloading stone from cars	362 50
Hauling stone, including loading	849 80
Spreading stone	324 90
Trimming shoulders and side roads	2 00
Rolling and sprinkling	68 90
Coal, oil and supplies	29 80
Heating bituminous binder	24 50
Hauling and spreading binder	39 00
7,000 gallon Tarvia X @ 6½c F. O. B.	455 00
Freight on binder	60 80
Freight on stone	1,453 40
Total	$3,858 85

COST PER CUBIC YARD FOR PLACING STONE.

Unloading stone from cars	$0.137
Hauling stone, including loading	.405
Spreading stone	.155
Rolling and sprinkling	.033
Coal, oil and supplies	.014
Total	$0.744

COST PER GALLON FOR APPLYING BITUMINOUS BINDER.

Heating	$0.0035
Hauling and spreading	.0056
Total	$0.0091

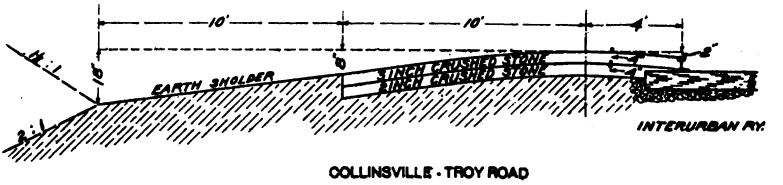
COST PER SQUARE YARD FINISHED TAR MACADAM.

Superintendence	$0.012
Excavation	.005
Shaping road bed	.012
Trimming shoulders and side roads	.000
Placing stone	.253
Cost of 2.25 gallon binder	.170
Applying binder @ 2.55 gallon, square yard	.023
Freight on binder	.022
Freight on stone	.225
Total	$0.722

COLLINSVILLE.

Collinsville-Troy Road, Collinsville Township, Madison County.

The Collinsville experimental road is built on the road between Collinsville and Troy. The macadam begins on this road, 500 feet south of the Collinsville city limits and extends southward 5,300 feet. There is an interurban railway along the side of the highway, the right of way being on the highway, and it was necessary to place one edge of the macadam next to the track.



COLLINSVILLE - TROY ROAD

Figure 8.

The soil on which the road was built is a light red clay. The country is rolling and the road has two grades of about two per cent. Stone for the improvement was furnished from the penitentiary at Chester, a

part of it being shipped and unloaded during the winter. The freight on the stone and cost of hauling and placing it was paid from township funds.

Length of road	5,300 feet
Width of macadam	14 feet
Macadam in road	8,245 square yards
Stone in road	2,625 cubic yards
Stone hauled from cars	1,525 cubic yards
Stone hauled from storage	1,100 cubic yards
Average haul of stone	⅜ mile
Rate of pay	men, 19c and 20c; man and team, 37½c per hour

COST OF LABOR AND SUPPLIES.

Superintendence	$ 96 25
Excavation	462 25
Shaping road bed	100 60
Unloading stone from cars	393 85
Hauling stone, including reloading	973 00
Spreading stone	153 90
Trimming shoulders and side road	170 00
Rolling and sprinkling	149 25
Watchman and miscellaneous labor	124 00
Coal, oil and supplies	36 60
Freight and car service	2,358 95
Total	$5,018 65

COST PER CUBIC YARD FOR PLACING STONE.

Unloading stone from cars	$0.150
Hauling stone	.370
Spreading stone	.059
Rolling and sprinkling	.057
Watchman and miscellaneous labor	.047
Coal, oil and supplies	.014
Total	$0.697

COST PER SQUARE YARD FINISHED MACADAM.

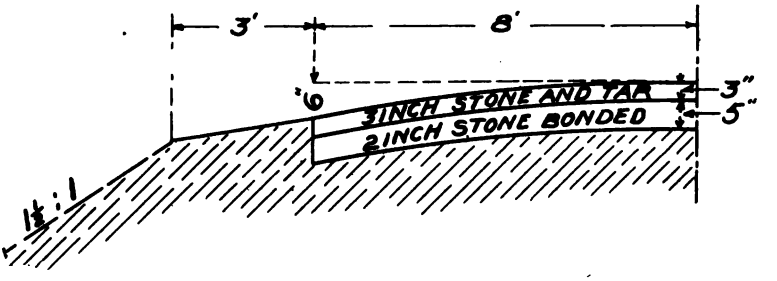
Superintendence	$0.012
Excavation	.056
Shaping road bed	.012
Trimming shoulders and side roads	.021
Placing stone	.222
Freight and car service	.285
Total	$0.608

EAST ST. LOUIS.

Tri-City Road, Venice Township, Madison County.

The Tri-City road extends from the St. Clair avenue bridge in East St. Louis through the Mississippi river bottoms to the brick pavement at Venice, a distance of 10,300 feet. For most of its length the road had been built on an embankment to keep it above the flood waters of the Mississippi. There were a few places in the road, however, which

were under water nearly every spring, making it impossible for loaded trucks to use the road. Inasmuch as the road is subjected to a very heavy tonnage at all seasons of the year, it was decided to raise the road-bed entirely above ordinary flood water and to surface it 16 feet wide, with crushed stone treated with a tar binder.



EAST ST. LOUIS & TRI CITIES ROAD

Figure 9.

The State Highway Commission was requested to assist in the work by the township commissioners of Venice township. Inasmuch, however, as the road is used very largely by business interests of East St. Louis, the financial part of the improvement was handled by a committee from the Commercial Club of East St. Louis, and great credit is due this committee for the successful completion of the project.

Stone for the surface was furnished from the State penitentiary at Chester. For filling, cinders from the various factories around East St. Louis and clay sand from the river banks were used. The surface was treated with Barrett's Tarvia X, and dressed with crushed chats obtained from zinc mines in Missouri a few miles from St. Louis.

Five sizes of stone were used at East St. Louis as follows: 3-inch limestone, 2-inch limestone, one-half inch to one-quarter inch limestone chips, limestone screenings one-half inch down and one-quarter inch chats.

Upon the sub-grade which was of mixed cinders and clay a 6-inch course of 2-inch limestone was spread, thoroughly rolled, filled with screenings and water bound. Upon this bonded course four inches of 3-inch limestone was spread, thoroughly rolled and the voids filled with limestone chips, care being taken to brush the surface clean. Upon this surface 1.6 gallons of Tarvia X per square yard was spread and covered with one-half inch of chats and rolled. After the rolling, the surface was gone over with a stiff broom to secure a uniform distribution of the chats, and again rolled, then opened for traffic. On a part of this work, because of a delay in receiving the chats, the tar was spread and allowed to stand about eighteen days before the chats were put on. On a section of the road which had been built on a newly made fill, a second treatment of three-quarter gallons to a square yard of Tarvia X was made, covered with chats and rolled.

Atmospheric temperature during tarring was 60° to 85° F. The tar was poured at a temperature of 200° to 220° F.

Upon the completion of the above work, the road was extended to accommodate a large tonnage using the extension. This part of the road was a water bound macadam, 18 feet wide and 8 inches thick.

Length of road	10,300 feet
Width of macadam	16 feet
Macadam laid	18,310 square yards
Stone in road	5,796 cubic yards
Stone hauled from storage	1,449 cubic yards
Average haul of stone and tar	½ mile
Surface finished with bituminous binder	16,530 square yards
Amount of Tarvia X used	26,000 gallons
Rate of pay	men 17½c and 20c per hour; teams, 42.5c per hour
Amount of excavation	9,000 cubic yards

COST OF LABOR AND SUPPLIES.

Superintendence	$ 374 55
Excavation	2,762 00
Shaping road bed	277 35
Unloading and hauling stone	2,786 00
Spreading stone	615 65
Trimming shoulders and side roads	121 40
Rolling and sprinkling	308 10
Watchman and miscellaneous labor	250 50
Coal, oil and supplies	299 21
Freight on stone, tar and chat	3,650 31
Cost of bituminous binder F. O. B.	1,690 00
Heating bituminous binder	40 00
Hauling bituminous binder	39 95
Spreading bituminous binder	96 20
Total	$13,140 22

COST PER CUBIC YARD FOR PLACING STONE.

Unloading and hauling stone	$0.480
Spreading stone	.106
Rolling and sprinkling	.053
Watchman and miscellaneous labor	.042
Coal, oil and supplies	.052
Total	$0.733

9,000 cubic yards excavation @ $0.31 per cubic yard.

COST PER GALLON FOR APPLYING BITUMINOUS BINDER.

Heating	$0.0015
Hauling	.0015
Spreading	.0037
Total	$0.0067

COST PER SQUARE YARD FINISHED MACADAM.

Superintendence	$0.020
Shaping road bed	.015
Trimming shoulders and side roads	.0[illegible]

Placing stone	$0.235
Applying bituminous binder	.014
Cost of bituminous binder	.104
Freight on tar and stone	.200
Total	$0.595

OLNEY.

Walnut Street Road, Olney Township, Richland County.

This road extends northward on Walnut street from the end of the brick pavement past the cemetery to a cross road, a distance of 4,820 feet. Two thousand feet of this road, beginning at the pavement, was made 16 feet wide, the remainder was 12 feet wide. The soil on which the road was constructed is a light clay, and the country is somewhat rolling, so that there was a considerable amount of excavation to be done. When completed the road had two or three grades of about two per cent.

Stone for the improvement was furnished from the penitentiary at Chester. The freight and cost of hauling and placing the stone was paid in part by the city of Olney; in part from a fund raised by subscription, and in part from funds in the hands of the Commercial Club of Olney. The Commercial Club of Olney was particularly active in securing this improvement, and great credit is due to its members for their interest in the matter.

Length of road	4,820 feet
Width of macadam	2,090 feet, 16 feet wide; 1,730 feet, 12 feet wide
Macadam laid	6,025 square yards
Stone in road	2,400 cubic yards
Stone hauled from cars	1,200 cubic yards
Average haul of stone	1 mile
Rate of pay	men, 15c per hour; man and team, 30c per hour

COST OF LABOR AND SUPPLIES.

Superintendence	$ 81 68
Excavation	331 70
Shaping road bed	41 55
Unloading stone from cars	278 81
Hauling stone (including reloading stone)	492 75
Spreading stone	153 15
Trimming shoulders and side road	42 10
Rolling and sprinkling	103 70
Watchman and miscellaneous labor	27 00
Coal, oil and supplies	87 06
Freight on stone	2,093 00
Total	$3,732 50

COST PER CUBIC YARD FOR PLACING STONE.

Unloading stone from cars	$0.115
Hauling stone (including reloading)	.201
Spreading stone	.064
Rolling and sprinkling	.043
Watchman and miscellaneous labor	.012
Coal, oil and supplies	.036
Total	$0.471

COST PER SQUARE YARD FINISHED MACADAM.

Superintendence	$0.0135
Excavation	.055
Shaping road bed	.007
Trimming shoulders and side roads	.007
Placing stone	.190
Freight on stone	.350
Total	$0.6225

HARRISBURG.

Independence Road in Harrisburg Township, Saline County.

The part of the Independence road that was improved begins at the Big Four tracks in the southeastern part of the town of Harrisburg and extends a mile south. It is a narrow road lying in the bottom and having poor drainage. The soil is a black loam, and the part of the road that was improved is level. The stone road was made 12 feet wide, and the road was widened to 50 feet in order to give an earth drive at the side of the macadam. Stone for the improvement was furnished from the penitentiary at Chester. The freight was paid by the township commissioners from the township funds. Most of the stone was hauled by donated labor, but in the cost table this labor is included at the prevailing rate of pay. It should be mentioned in connection with this work that the farmers who would be benefited by this particular road were more than willing to furnish teams for hauling material. Various incidentals and expenses connected with the construction were paid from the township funds. In order to take care of the drainage, two culverts and a 30-foot steel bridge were constructed. On account of poor drainage and adverse weather conditions, the earth which had to be moved in shaping the road was very difficult to handle, and this added considerably to the cost of the work. The road crosses a very flat, swampy region and the road was improved on the understanding that a drainage ditch would soon be dug to drain that section of the township. If this is not done, there is every probability that the road will not hold up because the foundation is poor.

Length of road	5,025 feet
Width of macadam	12 feet
Macadam in road	6,700 square yards
Stone in road	2,180 cubic yards
Stone hauled from cars	2,180 cubic yards
Average haul of stone	¾ mile
Rate of pay	men, 19c; man and team, 37½c per hour

COST OF LABOR AND SUPPLIES.

Superintendence	$ 178 00
Excavation	424 30
Shaping road bed	112 05
Unloading stone from cars	198 60
Hauling stone	752 90
Spreading stone	255 75
Trimming shoulders and side roads	11 90

Rolling and sprinkling	$ 178 20
Watchman and miscellaneous labor	30 80
Coal, oil and supplies	48 25
Freight and car service	3,100 00
Total	$5,290 75

COST PER CUBIC YARD FOR PLACING STONE.

Unloading stone from cars	$0.091
Hauling stone	.345
Spreading stone	.113
Rolling and sprinkling	.082
Watchman and miscellaneous labor	.014
Coal, oil and supplies	.022
Total	$0.666

COST PER SQUARE YARD FINISHED MACADAM.

Superintendence	$0.026
Excavation	.063
Shaping road bed	.017
Trimming shoulders and side roads	.002
Placing stone	.218
Freight and car service	.0462
Total	$0.788

OILED EARTH ROADS.

The extensive use of crude petroleum oil on the roads of California has attracted widespread notice, and from many residents of Illinois who had seen these California roads came the suggestion that crude oil might work well on Illinois earth roads. In fact many in the State who had not seen the California roads, but had read about them, thought such construction should be attempted. However, no road of this character had been built until the construction of two short sections of oiled earth road and somewhat similar construction of a gravel road were undertaken by the State Highway Commission during 1908.

The first use of oil on the roads was for the purpose of laying the dust, and was applied merely as a surface treatment. This was soon found to be undesirable, for as the oil soaked crust that was formed caked and cracked from the surface, it would be ground into mud during a rain and formed a very unpleasant road covering. An attempt was then made to incorporate the oil thoroughly with a thicker layer of the top soil of the road. This form of construction was not tried until a few years ago, of which there is considerable around Los Angeles and a small amount near Kansas City. It was a study of this latter work which first led to a decision to attempt similar work in Illinois. Later, an inspection of the oil work about Los Angeles was made.

As there were evidently many objectionable features to this form of construction, the commission did not feel warranted in expending any very large sums in an experiment of this character, at least not until more definite information could be had from the results of the work that had been attempted.

The great difference in climatic conditions between Southern California and Illinois seemed in the popular mind to be probably the chief obstacle to be overcome, or, rather, that the conditions in Illinois were such as to preclude this form of construction. It was assumed, that the construction had been successful in California; such, however, is not the case, the fact being, that during hot weather these roads suffer most and that during cold weather when the oil is congealed and the roads are harder, they remain in very much better condition. So it was with the experience had on the two pieces of earth roads treated, one at Springfield, the other at Bement, which are described in detail in the following pages. They gave much better service during the winter and spring than during the warm weather. One great advantage in favor of the

California work is the character of the oil that is available. The crude petroleum obtained from wells near by has no paraffin whatever, and many of these oils can be used without any refining process with most excellent results, while practically all the oil that is obtainable in Illinois must be refined and, if this is not successful, leaves ingredients in the oil which are not desirable for road construction purposes. It is necessary to use an oil which hardens, that is, one which does not remain greasy, as will be the case if any paraffin oil is present.

The chief objection to this form of construction is the soft or plastic character of the road surface, so that wherever the traffic is confined to one portion of the road surface, there inevitably will form a rut, as the plastic material tends to squeeze out. It was observed on the California roads that those sections which appeared to the best advantage were ones on which the traffic for one reason or another spread over the entire road surface evenly. As is well known, on the ordinary country road, it is practically impossible to get traffic to use the entire road surface, so that this form of construction will probably not prove desirable for country road work.

There is, however, some offset to this disadvantage from the fact that it seems possible to put a road which becomes out of shape in good condi-

seems possible to put a road which becomes out of shape in good condi-

tion again without much work. That is, not more than perhaps would ordinarily be used to keep up an earth road. If this can be done, so as to carry the road through the winter in practically a mudless condition, it is evident that a great gain will have been made. The question that cannot be answered at present, however, is whether this gain will be made at a cost that is not out of proportion to the benefits attained. The following is a detailed account of this construction so far made by the Illinois Highway Commission.

Country Club Road, Woodside Township, Sangamon County. Constructed in 1908.

The soil upon which this oiled earth experiment was tried is a yellow timber clay and the road is rolling and only fairly well drained, some sections, in fact, being very poorly drained. In the construction, the middle part of the road, about 15 feet in width, was plowed up and the material broken up by means of a disc harrow and finely pulverized and graded out to the side of the road. The foundation upon which the oil earth construction was to be placed was thoroughly compacted with a steam roller and alternate layers of earth and asphaltic oil placed on this foundation, thoroughly mixed and rolled. The thickness of the oil earth layer when completed was about 4 or 5 inches. It was found on this soil fairly easy to accomplish the mixing and on these sections where the mixing was best, it was noticed that the final results were much better than on the sections of the road on which the mixing was only imperfectly done. It seems, therefore, that the most important thing in this construction, aside from choosing suitable oil, is to secure a perfect mixing of the materials. Oil that was used in the experiment was a petroleum residue, known as an 85 per cent asphaltic oil. The following table is an itemized statement of the cost of the work:

Length of road	3,600 feet
Width treated	15 feet
Road treated	6,000 square yards
Average haul of oil	2 miles
Oil used	15,000 gallons
Road sanded	1,500 square yards
Labor cost	men, 20c per hour; man and team, 37½c per hour

COST OF LABOR.

Superintendence	$100 00
Shaping roadbed	184 98
Mixing oil and earth	95 00
Heating oil	136 20
Hauling oil	109 15
Distributing oil	48 00
Rolling	73 00
Watchman and miscellaneous labor	68 00
Hauling and spreading sand	34 00
Total	$848 33

LABOR COST PER GALLON FOR APPLYING OIL.

Heating	$0.0091
Hauling	.0073
Distributing	.0032
Total	$0.0196

TOTAL COST PER GALLON FOR APPLYING OIL.

Labor	$0.0196
Coal and supplies	.0016
Rental on traction engine	.0048
Total	$0.026

COST PER SQUARE YARD OF FINISHED ROAD.

(Three Gallon Treatment.)

Superintendence	$0.0167
Shaping roadbed	.034
Mixing oil and earth	.0157
Applying oil @ 3 gallons to square yard	.078
Rolling	.0122
Watchman and miscellaneous labor	.0113
Hauling and spreading sand	.0226
Supplies	.0800
Road oil	.1500
Total	$0.42

TOTAL COST OF ROAD.

Labor	$848 33
Coal and lubricating oil	33 58
Asphalt oil	750 00
Miscellaneous supplies	15 00
Total	$1,646 91

Ivesdale Road, Bement Township, Piatt County.
Section 1. Constructed in 1908.

The oiled earth road was constructed on a black, gumbo soil by mixing with the upper layer of the road an asphaltic oil in such an amount as to give a layer about 5 inches thick which was treated with oil in as large a quantity as it would absorb. In general, the method of construction was as follows:

The center of the road for a width of about 15 feet was plowed up, disked and pulverized as fine as possible. The pulvarized earth was then moved to the side of the road and the middle portion of the roadbed, on which the oil was to be used, was shaped and thoroughly compacted with a ten ton steam roller. Alternate layers of oil and earth were then placed on this foundation, thoroughly mixed with a disc harrow and rolled. The road was finished by putting on a light layer of earth and rolling the surface.

In the construction, numerous difficulties were encountered, particularly in getting proper mixtures of the earth and oil. This mixture when once made was of such a gummy nature that it was almost impossible to get it evenly distributed over the surface of the road, also the nature of the soil was such that it could not be entirely reduced to dust and there were numerous large clods in the mixture which were not broken up in any of the operations and remained in the surface of the road after its completion. It was found that the oil never impregnated these larger pieces of earth.

Subsequent work on this road showed that the earth and oil mix more uniformly if the earth is moistened with water during the mixing process. At first the road is very soft but as the water dries out the oil apparently takes its place and the surface becomes harder. During this time the road should be rolled and kept smooth.

The following table is an itemized statement of the cost of this road:

Length of road	1,550 feet
Width of treated road	12 feet
Square yards of road treated	2,065
Average haul of oil	½ mile
Gallons of oil used	8,200
Square yards covered with sand	735
Labor	cost of men, 17½c per hour; man and team 30c per hour

COST OF LABOR.

Superintendence	$ 16 00
Shaping road bed	31 00
Mixing oil and earth	13 50
Heating oil	8 00
Hauling oil	24 50
Distributing oil	8 50
Hauling water	4 00
Rolling	35 00
Miscellaneous labor	4 00
Sanding	9 00
Total	$153 50

COST PER SQUARE YARD FINISHED ROAD.

Superintendence	$0.0077
Shaping road bed	.015
Mixing oil and earth	.0065
Rolling	.019
Sanding	.0122
Applying 3 gallons oil to square yard	.015
Cost of 3 gallon oil F. O. B. Bement	.24
Total	$0.3153

LABOR COST PER GALLON FOR APPLYING OIL.

Heating	$0.00097
Hauling	.00298
Distributing	.00104
Total	$0.00499

TOTAL COST PER GALLON FOR HEATING AND APPLYING OIL.

Labor cost	$0.00499
Coal	.008
	$0.01299

TOTAL COST OF ROAD.

Labor	$153 50
Coal and lubricating oil	8 25
Sand	16 49
Oil	656 00
Miscellaneous supplies and repairs	7 25
Total	$841 49

Ivesdale Road, Bement Township, Piatt County.
Section 2. Constructed in 1909.

The oil experimental road was built on the Ivesdale road beginning at the west end of the oil road built in 1908 and extending westward a distance of 2,618 feet. The soil is black gumbo and the road was fairly well shaped and drained before the oil construction began. The road was treated for a width of 12 feet, midway between fences.

The work of applying the oil was undertaken late in the fall and on account of delays due to rainy weather and failure of some machinery to arrive, the work was unduly expensive and was somewhat imperfectly finished. The road was placed 6 inches deep for a width of 12 feet and the earth thus loosened, moved to the side with a grader. The 12-foot width to be oiled was crowned and tamped with a tamping roller. On account of continued rainy weather, it was impossible to get this foundation as hard as was desired.

Upon this foundation, one gallon per square yard of liquid asphalt was spread with a distributing wagon and covered with 3 inches of loose earth brought in from the side. The earth and oil were then mixed with a disc harrow and rolled with a tamping roller. The mixing and tamping was carried on with the earth very wet.

When the mixture was tamped as hard as could be done, a second application of 1½ gallons per square yard of the oil was put on. The remainder of the earth that had been graded out was put back and mixed with the oil while very wet with a disc harrow. It was then rolled with a tamping roller until as hard as could be made and finished off with a 6 ton smooth roller. On account of frequent rains, the road became so soft that it could not be rolled as hard as desired and the first travel after it was opened produced some ruts.

During the following spring, 1910, the road became solid and improved greatly. A later report will be made giving a summary of all the work of this character that has been undertaken.

The following table is an itemized statement of the cost of the road:

Length of the road oiled	2,618 feet
Width of road oiled	12 feet
Square yards of road oiled	3,500 feet
Gallons of asphaltic oil used	8,140
Length of haul of oil	¼ mile
Rate of pay	men, 17½c per hour; teams, 30c per hour

COST OF LABOR AND SUPPLIES.

Superintendence	$ 12 00
Excavation	20 00
Hauling and spreading oil	26 00
Replacing earth, tamping and mixing	60 00
Heating oil	15 00
Miscellaneous labor	12 00
8140 gallons oil @ 8c delivered	651 00
Total	$796 00

COST PER GALLON FOR APPLYING OIL.

Heating	$0.00184
Hauling and spreading	.00320
Total	$0.00504

COST PER SQUARE YARD OF FINISHED ROAD @ 2.32 GALLONS PER SQUARE YARD.

Superintendence	$0.0035
Excavation and shaping road bed	.0057
Applying oil	.0116
Replacing earth, tamping and mixing	.0172
Miscellaneous labor	.0035
2.32 gallons @ 8c gallon delivered	.1856
Total	$0.2272

The Naperville Experiment.

Naperville Township, DuPage County.

Several experiments were made on this road, the nature of which is shown by the accompanying descriptive table. They were intended to demonstrate the possibilities of treating old macadam or gravel roads

with some asphaltic or tar compounds in order to preserve the surface against the effects of automobile travel, of which there is considerable on this road.

It will be noted in the table of cost data, accompanying the description of this road, that only the labor cost is given, but knowing the quantity of materials used and their price, the total cost for a given piece of work may be approximated.

As this work was experimental, it is probable that under ordinary conditions and when an extensive project was under construction, it might be reduced somewhat.

Division of the Road Into Sections and Nature of the Experiment on Each Section.

Sec. 1. Washington street from Bridge to High street.
(a) Old gravel reshaped and rolled.
(b) Three-inch Aurora slag of 1-inch size spread and rolled.
(c) Two gals. per square yard Tarvia A poured on surface.
(d) After five days, slag screenings spread on surface and rolled.

Sec. 2. High street, beginning at Washington and extending one block west.
(a) Old gravel road reshaped and rolled.
(b) Four inches of 1-inch size slag spread and rolled.
(c) One-half-inch sand rolled into interstices.
(d) Two gals. liquid asphalt per square yard applied.
(e) Surface covered with slag screenings and rolled.

Sec. 3. High street, commencing at end of second section.
(a) Old gravel road reshaped and rolled.
(b) Four inches of 1-inch size slag spread and rolled.
(c) One-half-inch sand rolled into interstices.
(d) Two gals. Tarvia A per square yard applied.
(e) Surface covered with slag screenings and rolled.

Sec. 4. High street from section 3 to the city limits.
(a) Seven inches sandy gravel spread on old gravel bed and harrowed.
(b) Two gals. per square yard Tarvia applied in two applications, harrowing after each application.
(c) Wet thoroughly and rolled.
(d) Surface covered with slag screenings and rolled.

Sec. 5. Sixty feet across end of High street at city limits.
(a) Four inches of top of old gravel road loosened and graded off roadway.
(b) One and one-half gals. liquid asphalt per square yard applied to foundation.
(c) Gravel graded back and wet and rolled.

Sec. 6. City limits to first turn on Aurora road.
(a) Four inches of 2-inch size limestone spread and rolled.
(b) Two gals. per square yard liquid asphalt applied.
(c) Watered and rolled.

(d) One and one-half inches of limestone screenings spread, watered and rolled.

Sec. 7. 720 feet along Oswego road from its intersection with Aurora road.

(a) Six inches of gravel spread on old gravel road.

(b) Watered and rolled.

(c) Two gals. per square yard liquid asphalt applied.

(d) Three inches of crusher run limestone spread.

(e) Rolled until oil showed on surface.

Sec. 8. 1,000 feet on Oswego road from end of section 7.

(a) Old gravel road spiked up.

(b) One and one-half gals. liquid asphalt applied, harrowed and rolled.

Sec. 9. 1,350 feet on Aurora road beginning at W. R. Goodwin's barn lot gate.

(a) Four inches top removed from old gravel road.

(b) One and one-half gals. liquid asphalt per square yard applied.

(c) Gravel graded back, watered and rolled.

Sec. 11a. 100 feet south on Washington street, beginning at High street.

(a) Old gravel road reshaped and rolled.

(b) Four inches of 2-inch size, slag spread and rolled.

(c) One-half inch sand rolled into interstices.

(d) Two gals. liquid asphalt per square yard applied.

(e) Surface covered with sand and rolled.

Sec. 11b. 100 feet on Washington street, extending from Sec. 11a.

(a) Seven inches sandy gravel, spread on old gravel bed and harrowed.

(b) Two gals. per square yard Tarvia applied in four applications, harrowing after each application.

(c) Wet thoroughly and rolled.

(d) Surface covered with slag screenings and rolled.

Sec. 11. 1,000 feet on Washington street, extending from Sec. 11b.

(a) Seven inches sandy gravel spread on old gravel street and harrowed.

(b) One and one-half gals. liquid asphalt per square yard applied and harrowed.

(c) First half covered with slag screenings; second half covered with limestone screenings.

(d) Watered and rolled.

Sec. 12. 1,000 feet on Washington street extending from Sec. 11.

(a) Seven inches sandy gravel spread on old gravel bed and harrowed.

(b) Two gals. per square yard Tarvia applied in 4-inch applications, harrowing after each application.

(c) Wet thoroughly and rolled.

(d) Surface covered with slag screenings and rolled.

(e) Surface covered with limestone screenings, watered and rolled.

Work on Parts of Washington Street, Oswego and Aurora Road, Naperville Township, DuPage County.

Length of road	7,200 feet
Width of road treated	10 to 27 feet
Treated gravel	9,660 square yards
Treated stone and slag	4,194 square yards
Average haul of gravel	1½ miles
Average haul of stone, slag and oil	1¼ miles
Stone used	278 cubic yards
Slag used	173 cubic yards
Gravel used	693 cubic yards
Number gallons oil used	8,200
Tarvia used	8,000 gallons
Labor cost	men, 17½c per hour; man and team, 45c per hour

COST OF LABOR.

Superintendence	$ 70 00
Excavation	63 50
Shaping roadbed	100 00
Unloading stone and slag	28 90
Loading gravel at pit	78 25
Hauling stone and slag	286 60
Hauling gravel	406 50
Spreading stone and slag	79 83
Spreading gravel	35 25
Trimming shoulders	68 65
Rolling and sprinkling	97 90
Distribution of oil and tar	75 35
Heating oil and tar	45 00
Watchman and miscellaneous labor	14 75
Total	$1,451 08

COST PER CUBIC YARD FOR PLACING STONE AND SLAG.

Unloading	$0.064
Hauling	.635
Spreading	.177
Rolling and sprinkling	.085
Watchman and miscellaneous labor	.013
Total	$0.974

COST PER CUBIC YARD FOR PLACING GRAVEL.

Stripping and loading at pit	$0.113
Hauling	.525
Spreading	.051
Rolling and sprinkling	.085
Watchman and miscellaneous labor	.013
Total	$0.847

LABOR COST PER GALLON FOR HEATING AND APPLYING OIL.

Labor heating	$0.002
Hauling and sprinkling	.0033
Total	$0.0053

TOTAL COST PER GALLON FOR HEATING AND APPLYING OIL.

Labor	$0.0053
Fuel	.0087
Rental on engine	.0027
Total	$0.0167

LABOR COST PER SQUARE YARD FINISHED ROAD.

Stone or slag; two gallons oil or tarvia per square yard.

Superintendence	$0.0051
Excavation	.0046
Shaping roadbed	.008
Placing stone or slag	.103
Trimming shoulders and side roads	.005
Applying 2 gallons oil or tar to square yard	.0132
Total	$0.1389

LABOR COST PER SQUARE YARD FINISHED ROAD.

Gravel with 2 gallons oil or tar to square yard.

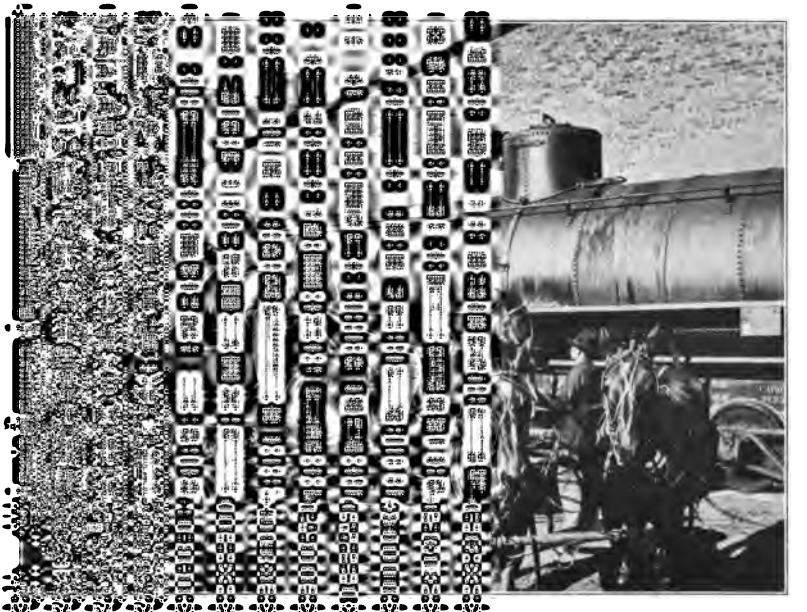
Superintendence	$0.0051
Excavation	.0046
Shaping roadbed	.008
Placing gravel	.0618
Rolling and sprinkling	.008
Trimming shoulders and side roads	.005
Applying oil or tar, 2 gallons to square yard	.0132
Total	$0.1057

During the latter part of the summer of 1909, certain sections of this work had developed an exceedingly bad road surface and it was necessary to make repairs.

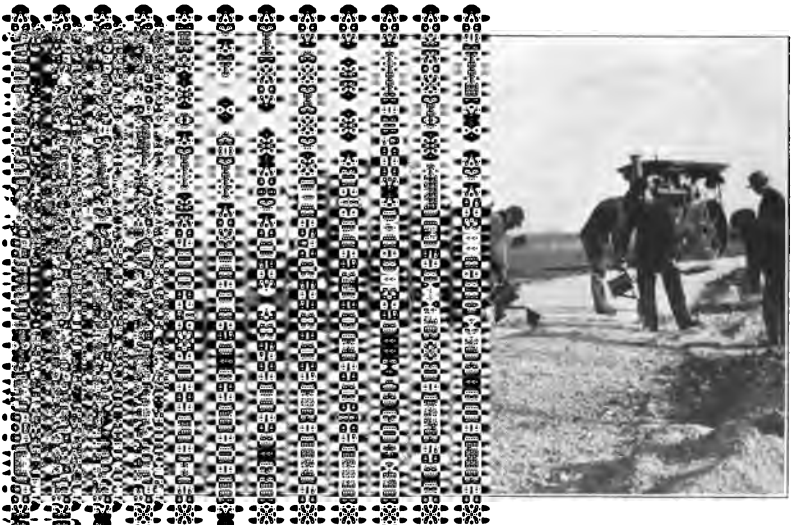
Section 6, which was originally treated with liquid asphalt, became sticky on top shortly after completion and it was necessary to cover it with gravel. This surface dressing was repeated several times and as a result, there was a putty-like layer of gravel and oil 4 inches thick on top of the stone. This layer was disagreeable to travel and hard to pull over and in 1909 it was all scraped off the surface and the stone redressed with limestone chips.

Sections 7, 8 and 9 developed uneven places and ruts apparently due to the fact that the oil and gravel were not well enough mixed during the original construction. These sections were plowed up in 1909, water soaked and harrowed until the oil was thoroughly incorporated with the gravel. The surface was then shaped and rolled. Since these sections were gone over, they have remained in a very satisfactory condition. Total cost of resurfacing, $383.49.

The photographs reproduced herewith show the condition of various sections of the road in 1910.



[illegible] in tank car by steam and [illegible] by air pressure.



[illegible] distributing wagon by hand. Care [illegible] to spread tar evenly. Usually, em- [illegible] and four men to pour. Rate of [illegible]

THE USE OF BITUMINOUS COMPOUNDS IN MACADAM ROAD CONSTRUCTION.

The rapid increase of motor traffic in all parts of the country has turned the attention of road engineers to the problem of devising means of constructing macadam and gravel roads in such a manner as to enable them successfully to resist the destructive action of this form of traffic. Also the action of sticky mud tracked upon macadam roads has a somewhat similar effect as is produced by motor traffic.

The most successful efforts, so far, to maintain macadam road surface under these conditions, have been in the application of bituminous binders, making what is known as a bituminous macadam as opposed to waterbound macadam.

The Illinois Highway Commission has made considerable use of bituminous compounds in road construction during the seasons of 1908, 1909 and 1910. The form of construction involving the use of these compounds was looked upon as entirely experimental and although there has been considerable progress made towards standardizing these materials and the methods of construction, involving their use, still it is thought that as yet the use of tars and asphaltic compounds for construction purposes must be considered as more or less experimental.

The roads that were built by the Illinois Highway Commission were constructed for the purpose of determining one or more of the following questions:

1st. The general desirability of the poured asphalt or tar macadam road as regard dustlessness, resistance to wear and comfort of travel.

2d. The relative cost of the waterbound macadam and the tar or asphalt poured macadam.

3d. The relative cost of maintenance of waterbound macadam and the poured asphalt or tar macadam.

4th. The suitability of an asphaltic oil in the construction of earth roads.

In the construction of bituminous macadam roads, it was decided to confine the experiments entirely to the poured macadam. It is a matter of common observation that on roads which are traveled exclusively or almost exclusively by farm teams, the traffic confines itself to seven or eight feet of the width of the road, the wheel wear coming entirely upon the two strips of the roadway which usually do not exceed two feet in combined width. Where this concentrated traffic is encountered,

there is a marked tendency for bituminous macadam to squeeze out along the wheel track, forming a broad depression. The wear also must necessarily be great where the vehicles all follow the same track. This depression will eventually become deep enough to hold water which hastens the deterioration of the road. On village streets there is no such tendency because the traffic must necessarily spread out more on account of the constant passing.

On account of these conditions it is essential in a poured macadam to design the road so that the lower course shall give stability and the surface course provide a durable wearing surface so placed that the opportunity for lateral displacement of the stone composing it is reduced to a minimum.

Four sizes of stone are used in the State experimental bituminous roads as follows:

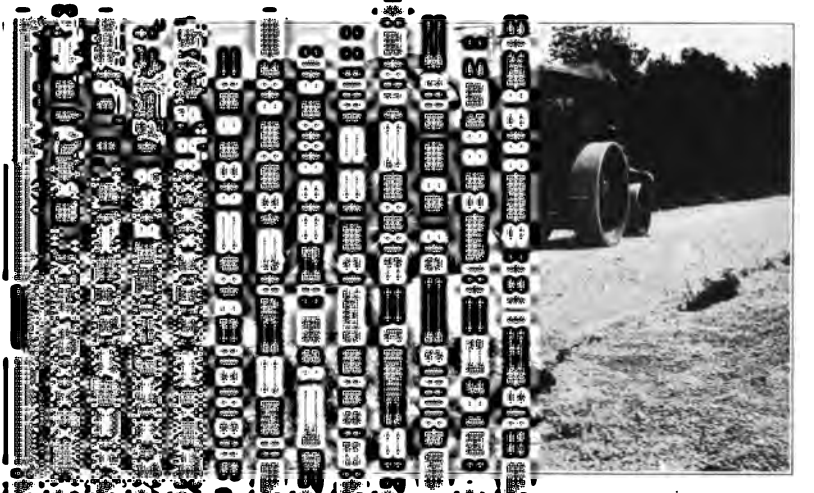
Stone passing over a 2-inch screen and through a 3-inch screen, designated as 3-inch stone.

Stone passing over a ¾-inch screen and through a 2-inch screen, designated as a 2-inch stone.

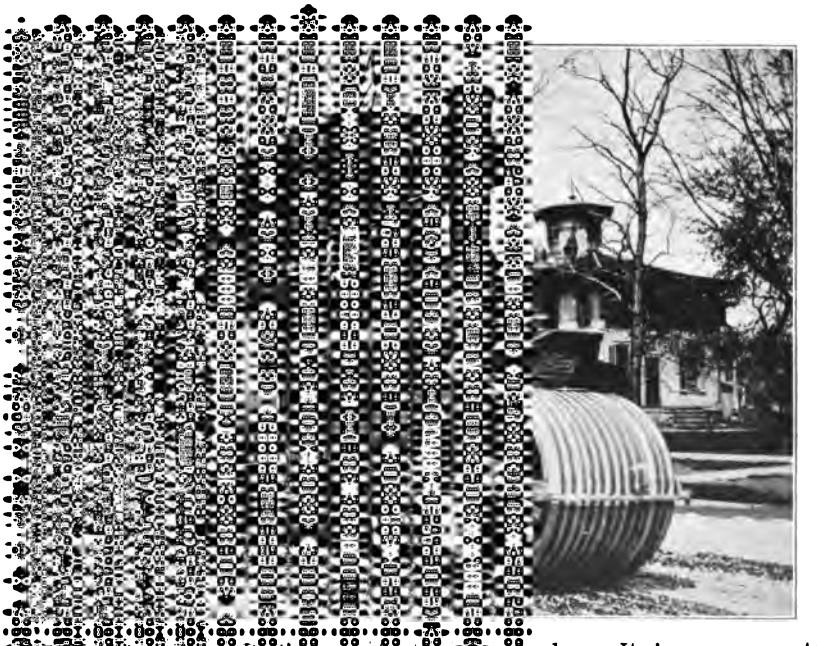
Stone passing over a ¼-inch screen and through a ¾-inch screen, designated as chips.

Screenings that pass through a ¼-inch screen, designated as dust.

In general, bituminous macadam roads have been made 9 inches thick at the crown line and 6 inches thick at the edge after rolling. The stone is placed in two courses, the top course being 2½ to three inches thick after rolling and the lower course 6½ inches thick at the crown line and 3½ inches thick at the shoulder or curb line after rolling. The lower course is spread, harrowed and rolled and bonded with water and screenings or dust, in the manner of an ordinary waterbound macadam roadway. It was learned early in the experiment that an essential part of this form of construction is to have the top course of uniform texture, and it was found that herein lay the greatest difficulty in the construction; unless every detail is carefully watched from the beginning, it is certain that there will be a lack of uniformity in this upper or wearing course. In order to insure absolute uniformity in thickness and texture of the upper course, the lower course must be laid carefully and finished absolutely true to cross section and grade in every particular. The top course of stone must then be spread with great care so as to insure uniform thickness; it must then be harrowed to bring a uniform sized stone to the surface and rolled until it is well keyed together. Where the 3-inch stone is used, it has often been found necessary to sprinkle over the surface after the first rolling a small quantity of 2-inch stone, and to roll this smaller size into the surface, which has the effect of pushing together the larger stones in the surface and keying them tight so that after this rolling has been done, the surface presented is so compactly knit together that without the addition of any binder, it is possible to haul a loaded wagon over it with but slight disturbance to the stone. When this condition is realized it seems that the ideal for a poured macadam has been reached. The upper course of stone now presents a surface which is sufficiently stable to carry the



ing wagon by steam pres-
stribution, 600 gallons per
spreading by this method



adam. It is necessary to
piping for this purpose is
m is rolled till firmly com-
again rolled for one course

weight of the loads which will come upon it. It only remains necessary to add to this surface something that will prevent the displacement of the stone.

It is estimated that this surface layer of stone will contain about 20 per cent of voids after the rolling. Theoretically all of these voids should be filled to prevent any displacement of the stone, which would require a little more than 2½ gallons per square yard of surface. Practically, however, this may not be essential because the stones composing the surface have been so locked together that there is no opportunity for lateral movement of any stone unless some of them are first removed from the surface. It is the function of the bituminous compound to prevent that and on the State experimental roads, 2 gallons per square yard has been the usual treatment. It will often be found that the surface of the road is so open that a smooth surface cannot be obtained without first filling the surface interstices and the chips are used for this purpose, being whipped into the interstices from the shovels. The surface is then broomed to sweep all chips into the voids leaving a clean surface. The voids are then poured practically full of the asphalt or tar binder.

In the use of bituminous compound for this purpose, two facts must be taken into consideration:

First—The material which is to be used for this purpose must be well chosen and must be appropriate to the conditions under which it will be applied.

Second—The application must be made in such a way as to insure that the material will go on the surface in a uniform layer and that the surface will be in such condition as to permit the material to flow into the interstices and to fill practically all of the voids in this upper layer of stone which has been discussed.

If a tar is used as a binder, the following method of application has been found to be very successful. The binder is received in tank car lots and is heated in the car by means of the steam coils provided in the cars for that purpose. In heating the tar, it is necessary that an ample supply of steam be provided and usually it has been secured from some power plant of large capacity. It is possible to heat the material in the tank car by this means to a temperature of 250 degrees Fahrenheit which is sufficient to make the tars used soft enough for their application. Undoubtedly the temperature at which the material is applied is of great importance, and the temperature which would be correct for one material will not be correct for another. The ideal condition to be reached is that the material shall be sufficiently fluid when it reaches the road to flow into the interstices before cooling. It must not remain as a mat on the top of the stone.

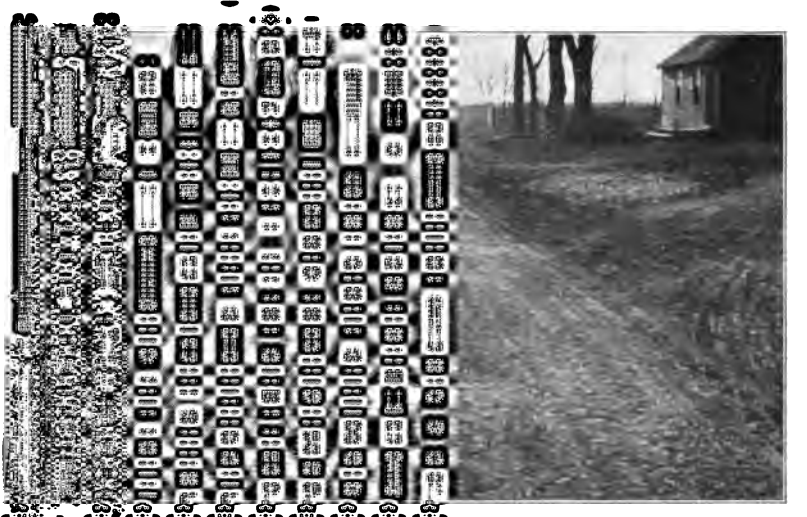
In handling tars, the material is forced out of the tank car into a distributing wagon by means of steam pressure applied to the top of the car. Steam pressure has not been found to be altogether satisfactory on account of the water which condenses and remains in the car. However, if pressure can be furnished by means of compressed air from a portable compressor, the method is entirely satisfactory. The material

is then drawn to the road in the distributing wagon and attached to a steam roller. Steam connection is made from the roller to the top of the distributing wagon and the tar, forced through a hose and nozzle, is then sprayed by means of the nozzle on the stone. This method of distribution is very satisfactory, it being possible to apply either large or small quantities of the material in a very uniform layer to the stone. The only objectionable feature so far observed is the slight amount of water which condenses in the tank wagon. This water turns into steam as soon as the new batch of hot binder is turned into the wagon and may cause the binder to foam.

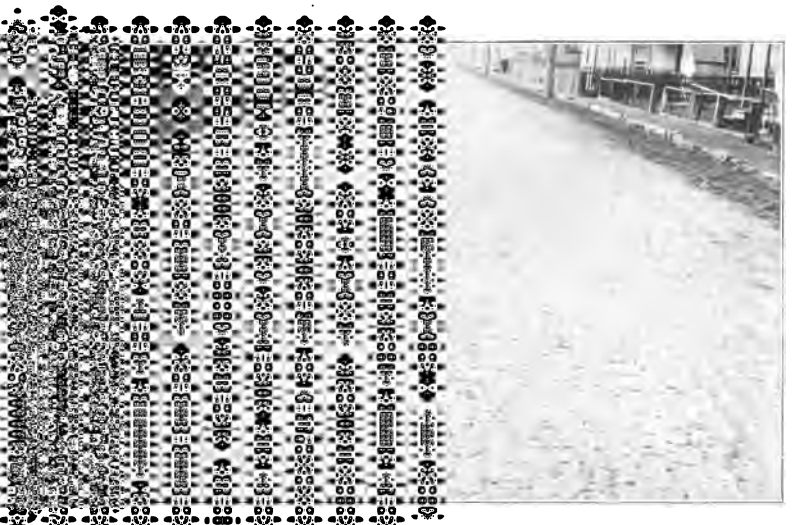
The same general method of application has been attempted with petroleum residuum compounds, but has not been found satisfactory because it is impossible to heat the binder sufficiently by means of the steam coil to make it flow through a hose. It cannot even be heated sufficiently to spread by means of hand spreading cans, filled from the tank wagon. At the temperature to which the material can be heated by steam, this method is not satisfactory because the material is not sufficiently fluid to flow into the interstices of the stone; the result is that there are patches on the surface of the road which are unsightly and make the surface uneven to an extent which is perceptible to those who traverse the road. In general, it is thought that asphalt compound should be applied to the road surface at a temperature not less than 300 degrees Fahrenheit, and in some cases the temperature would need to be considerably above that in order to get satisfactory results. The principle hereinbefore mentioned applies in this case, that the binder must be sufficiently fluid to flow into the interstices of the stone. It must not, however be heated to the flash point of the material especially if it is handled in an open kettle.

In using an asphaltic compound, the best results have been obtained when the material is heated in kettles, drawn off into hand sprinkling cans and poured onto the surface layer of stone.

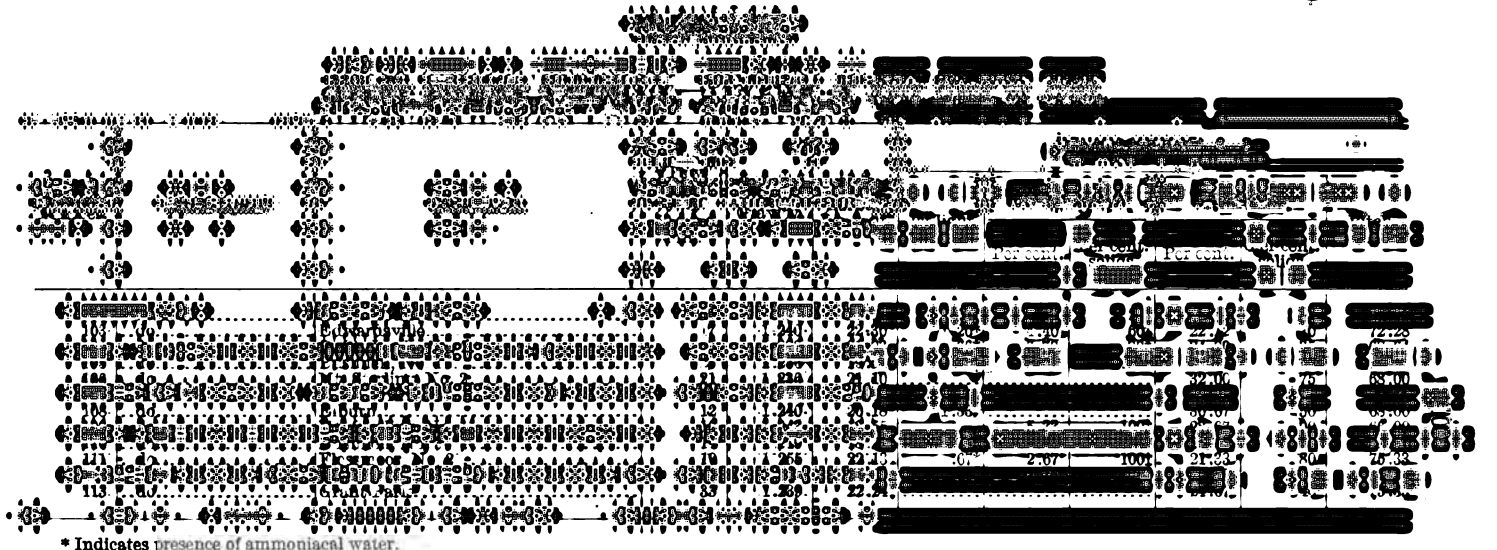
The first spreading of these compounds will leave the surface of the road slightly rough where individual stones have been disturbed by the men walking over the surface in spreading the compound, and project partly from the surface. By rolling this surface with a wet roller before a second spreading of asphalt is applied, this fault can be corrected. After the first spreading of bituminous compound, the surface of the road should be rolled and covered with stone chips thoroughly broomed into all of the interstices and voids that show in the surface of the road. This seems to be the most important operation aside from the pouring of the compound, but if it is carefully done an extremely uniform surface can be secured. After this spreading of chips has been carefully broomed, a second spreading of the bitumen in the nature of a paint coat is applied to the surface. This application should not exceed one-half gallon per square yard. In the first application the amount of compound must be determined by the nature of the surface layer of stone. Usually 1¼ to 1¾ gallons per square yard has been used on State work.



Typical Portion of one course treatment. Davis Township Road, McDonough County. Built, 1909.



Typical Portion of two course treatment. Tri-City Road, Granite City, St. Louis. Built in 1909.



* Indicates presence of ammoniacal water.
† Indicates presence of non-ammoniacal water.
‡ Indicates that solids were principally naphthalene.
§ Too soft to test.

Experience with the use of various bituminous compounds in construction work led to the conclusion that there are some important variations in the characteristics of the commercial preparations sold for use in road construction. In the absence of accepted standard specifications for these compounds, no attempt was made to secure compounds meeting a definite specification except in a few instances, but all materials used in 1909 were analyzed according to approved methods and a record made of the results. It is thought that a study of these analyses and a comparison of them with the behavior of the compounds on the roads will give information that may eventually be incorporated in a set of specifications.

Inspections were made in 1910 of roads built in 1909, and the condition of the various tars is summarized as follows:

Sample 101 gave fair results as a binder, holding the surface of the road intact and forming a slight mat on the surface which plainly showed the print of the shoes on the horses. During the hot weather the material softened sufficiently to flow out of the macadam on to the earth shoulder at the edge to some extent. The constant kneading of the mat surface seemed to deaden the material so that it began in places to separate from the stone and to become brittle. So far the wear is almost entirely on the mat of tar on the surface of the macadam.

Sample 103. The same general conditions were found as where the No. 101 was used except to a slightly less degree, with the probability that the life of this material will be somewhat longer than that of No. 101.

Sample 104. This material seemed to work out on the surface to an undesirable extent and became soft during hot weather, running onto the earth shoulders in large quantities. The mat on the surface is dead and brittle and peels from the stone. This seems to be the poorest tar used during the season. So far the mat of tar is taking all the wear.

Sample 105. This tar was used on a road so situated that large quantities of mud were carried on to it during the winter. The tar now appears to be dead and somewhat brittle and does not seem to have held the chips in the interstices of the upper layer of stone. The surface of the road is rough, the wear all coming on the stone.

Sample 106. No report received.

Sample 107. This material has held its life well on a very heavily traveled road. On about 60 per cent of the surface, the tar has worn off entirely, the surface presenting a mosaic appearance, each stone being surrounded by the tar, the stone forming the wearing surface. On the remainder of the surface, the tar forms a thin mat over the stone and is taking the wear and protecting the stone. This tar is apparently the best one used during the season. The road is dusty.

Sample 108. This tar was used in resurfacing work where a considerable quantity of stone dust and mud was found on the road. The tar became brittle and wore off the surface. There has been no loosening of the stone. It is thought that the poor results here were due in part to the fact that the tar was applied in cold weather. The road is dusty.

Tar Macadam. Two course treatment. West Cross street experimental work. Mt. Sterling, Brown County. Built 1909.

Sample 109. About the same results were obtained with this material as with No. 105, it being used under similar conditions.

Sample 110. This material was used under conditions similar to those where Nos. 105 and 109 were used. The results were better, however, the surface being fairly smooth. The chips held in place in the interstices of the surface. The stone is taking the wear and the surface presents a mosaic appearance. Very little dust was noted except where mud had been carried onto the road.

Samples 111 and 112. With these materials the stone is held in place but the wear is on the stone. The tars here become slightly brittle during cold weather, but in warm weather seem to regain their life. They did not soften enough to flow. The road is dusty.

Sample 113. This tar became brittle and the surface of the road cracked up under traffic, due, it is believed, to the fact that the tar was applied during cold weather, and that the road was not in proper condition for receiving the tar treatment.

In general, it may be said that all the roads were dusty except those that had an excessive mat of tar on the surface, and these were comparatively free from dust. This mat, however, is probably short lived and the conclusion is that all tar treated roads will become dusty within on, two or three years after construction, and that if the mat surface is not obtained, the roads will be dusty from completion. It may also be said that the surface layer of stone, in all cases, is held firmly in place, but that the finer particles in the interstices are not held in place by brittle tars.

It is probable that when the mat surface wears off one of these roads, it can be replaced by applying a proper grade of tar in the nature of a paint coat and that this will be the cheapest method of maintaining roads of this character.

It seems that some change must be made in the character of the tars available for construction purposes, to insure that they will not soften and flow in hot weather nor become brittle during cold weather. Just how this can be done is not at once apparent, but it is probable that the volatile light oils should be eliminated and the free carbon held as low as possible. There should also be a sufficient quantity of dead oils present to give elasticity to the pitch.

BRIDGE WORK.

Since the organization of the bridge department of the State Highway Commission, the demand for the advice of the commission in regard to bridge matters has increased rapidly from year to year. By referring to table XIV it will be observed that in 1906 the commission inspected twenty-six bridges; in 1907, 156 bridges; in 1908, 198 bridges and in 1909, 135 bridges, the bridges completed during the year and under construction at the end of the year were as follows: 1906, 11; 1907, 57; 1908, 77 and 1909, 109. These figures illustrate better than words the increasing demand for this service.

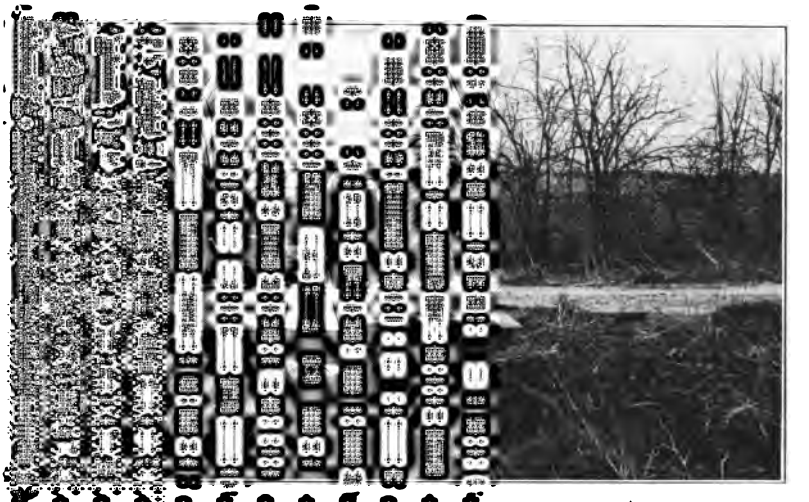
For each bridge inspected, the commission furnished an engineer to meet with the local officials and make such surveys as might be necessary to secure information for preparing plans and specifications, or for making a report on strength or desirable repairs.

Each year has seen a larger number of applications for bridge service than could be handled by the commission within the appropriation provided for this purpose.

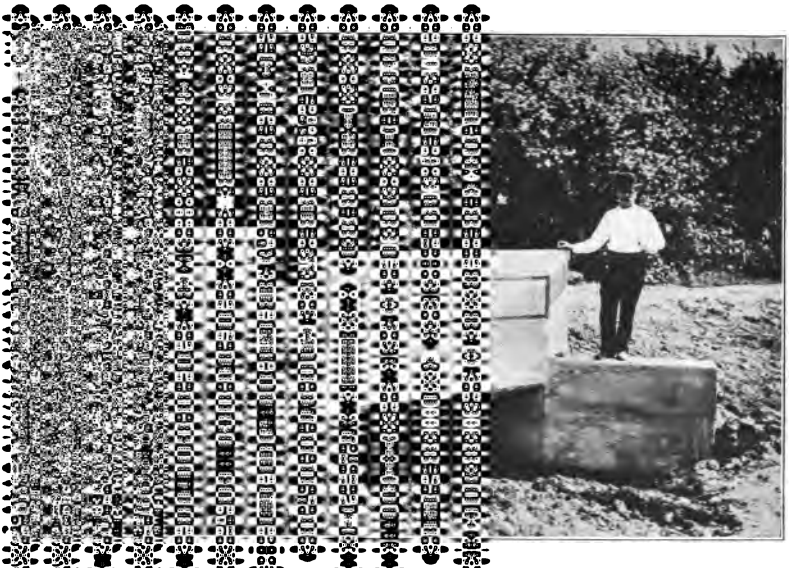
The development of standard plans and a systematization of the work, has, however, largely increased the amount of this work handled for a given expenditure. It is planned to still further increase the efficiency and output of the department by developing a more elaborate system of standards, but because of the fact that standards must constantly be revised to keep abreast of modern engineering practice and because of the fact that a large amount of special work, to which standards cannot be applied, is constantly being called for, any material increase in the work handled must be provided for by increased appropriation.

Bridge Applications Should Be Made in the Fall and Winter.

Applications for bridge work are received in greatest number during the months of May, June and July. A greater economy can be secured, not only in the construction of bridges, but also in the work of the commission if arrangements can be made to have applications for bridge work come to the commission in the late fall and early winter. More favorable prices can be obtained by letting contracts for steel bridges late in the fall for construction the following season as the shops of the bridge companies are then provided with work for the winter months when the general demand for structural steel work is not great. Some-



[illegible] County, before reconstruction. [illegible] of this character in Illinois. [illegible] on bridges is used in rebuilding [illegible].



[illegible] County, after reconstruction. [illegible] completed in 1909. Cost, $345.00. [illegible] by the Illinois Highway Commission. [illegible] culverts in Illinois are br[illegible] will not be more than one-

what better prices can also be obtained on concrete bridge work if contracts are let during the winter months. A contractor is not always able to provide employment for his construction foreman during the winter months which is profitable alike to himself and the foreman. He therefore, generally finds it desirable to figure close on work that he can start as early in the spring as construction work can be carried on safely, so that he can keep his old foreman, on whom he can rely, from going to a rival who might have contracts for early spring work.

The experience of the State Highway Commission has proven that competition is much closer on contracts let in the winter with plenty of time allowed for completing the work the following season than when contracts are let during the spring and summer with no more than a reasonable amount of time allowed for completing the work.

From the point of view of the State Highway Commission, if applications are received during the fall and winter, they may be handled much more expeditiously, as the engineers who are employed on construction work during the summer months are available to handle the preparation of the plans and specifications.

Local officials having bridge work in charge can, by making a careful study, determine in the fall or winter the structures which it will be necessary to replace or repair the following season. If this is done, the inspection made, plans and specifications prepared, and the contract let early in the winter, the result will be better prices and the bridges will be completed before traction engines and crops are moving over the highways the next season. When contracts are let in the spring or summer, unforseen circumstances often arise causing delay in the completion of the structures perhaps when they are most needed, and not infrequently concrete work is held up by cold weather and completion delayed until the following season.

Concrete Bridges.

As has been stated in previous reports and bulletins, concrete bridges for spans up to 50 feet or 60 feet in length can frequently be constructed at a cost not much greater and sometimes even less than that of a steel bridge equally well designed on concrete abutments. This is becoming a firmly established fact. The concrete bridge is a structure so much less expensive to maintain that the demand for plans for short span steel bridges is almost nil.

As a general thing the distance from finished roadway to bed of stream is not great and where this is true, by dividing a wide crossing into a series of short spans, it may often be possible to construct concrete bridges over wide streams at a reasonable expense.

Too much cannot be said of the desirability of building concrete bridges for the shorter spans and building concrete floors on all new steel bridges, as by so doing, the annual expenditure for bridges may be largely eliminated.

TABLE No. XV.

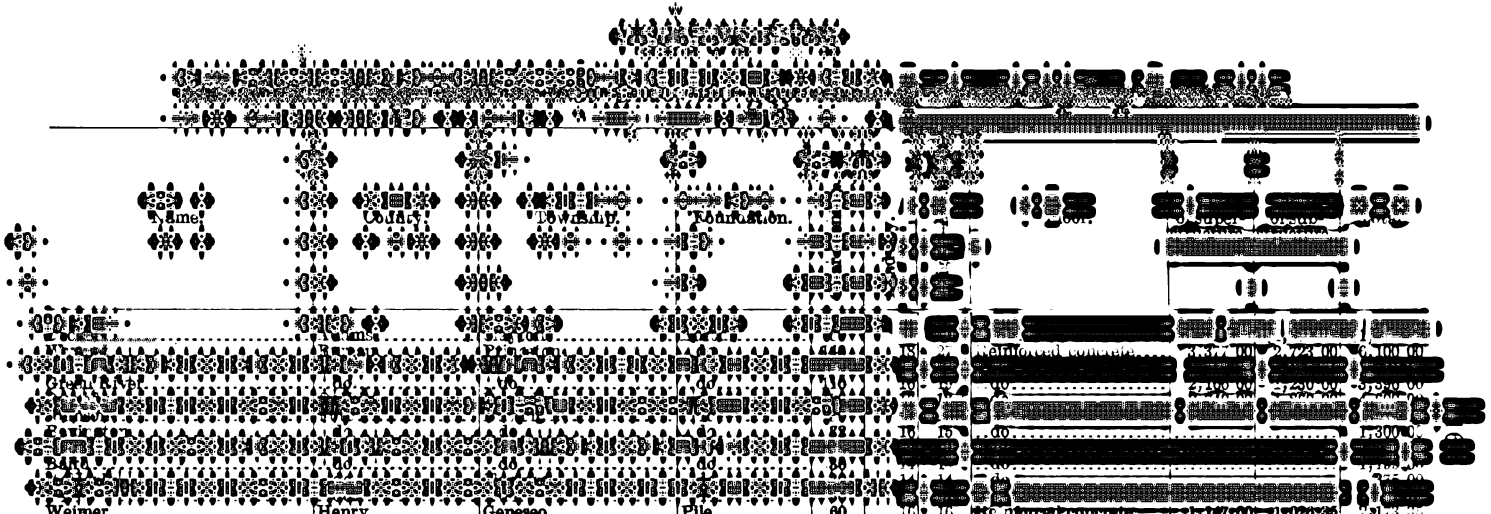
List of Steel Bridges Built in 1908 Under the Supervision of Illinois Highway Commission.

Name.	County.	Township.	Foundation.	Clear opening.	Roadway.	Height—Abutments	Floor.	Cost of superstructure.	Cost of substructure.	Total.
Kordsimon	Adams	Ursa	Pile	50	16	15	Reinforced concrete	$ 899 00	$1,240 00	$2,139 00
Bear Creek, repair work	..do	..do								450 00
Hopps	Bureau	LaMoille	Earth	100	16	19	Reinforced concrete	2,263 00	1,364 45	3,627 45
Long Creek	Hancock	Carthage	Pile	110	16	25	Wood	2,022 00	2,459 00	4,481 00
Rickel	Henry	Loraine	..do	40	16	16	..do	610 00	780 00	1,390 00
Urich	..do	..do	..do	60	16	15	..do	910 00	770 00	1,680 00
Weber	..do	..do	..do	50	16	15	..do	760 00	770 00	1,530 00
Rhodes	JoDaviess	Pleasant Valley	Earth	66	14	17.5	Reinforced concrete	940 00	910 00	1,850 00
Rush Creek	..do	Woodbine	..do	70	14	17.5	..do	1,459 00	1,130 00	2,589 00
Illinois River	LaSalle	Ottawa	Rock	900	24	.....	Brick	63,490 00	27,650 31	91,140 31
Gates	McHenry	Hebron	Old stone abutments.	60	14	.....	Reinforced concrete	1,048 00	.....	1,048 00
Rock River, repair work	Whiteside	Prophetstown			18	17	Wood	.....	.....	5,055 00
Whitsley	Winnebago	Seward	Old stone abutments.	50	16	23	Reinforced concrete	695 00	.....	695 00

TABLE NO. XVI.

List of Concrete Bridges Built in 1908 Under the Supervision of Illinois Highway Commission.

Name.	County.	Township.	Clear opening.	Width—Roadway.	Height—Abutments.	Total cost.
Hildebrand	Adams	Concord	18	14	11	$1,000 00
Culvert	Bond	Central	5	22	5	370 00
Krumweide	Cook	Rich	24	16	12.5	869 27
Lusenhop	..do	..do	21	16	11	441 86
Schramm	..do	..do	20	16	9	596 87
Anderson	Ford	Patton	12	16	8	318 00
Frette	..do	..do	20	16	12	680 00
Lindgren	..do	..do	8	16	7.5	177 70
Tackwell	..do	..do	6	16	7	122 85
Staggerman	..do	..do	8	16	6.5	191.25
Franklin St	Greene	Whitehall	14	60	15	1,424 75
W. Bridgeport	..do	..do	14	60	15	1,334 50
Nasland	Henry	Galva	8	20	6	Day labor
McHenry Gulch	..do	Phenix	14	60	12	4,287 00
Houpt	..do	..do	16	20	20	3,037 00
Grant	..do	Western	14	16	19	550 52
Craig	..do	Wethersfield	12	16	10	449 00
Lindblad	..do	Western	16	16	9	530 00
Combrink	Iroquois	Loda	12	16	7	300 00
Gibberson	..do	Mississippi	24	14	16.5	860 00
Wilson	JoDaviess	Warren	35	16	9.5	1,149 40
Johnson	Kendall	Lisbon	30	16	8.5	825 00
McKie	Knox	Walnut Grove	12	16	11.5	718 00
Ostrom	..do	..do	10	14	7.5	471 70
Jno. Frail	..do	..do	10	14	10.5	718 00
Gleim	LaSalle	Grand Rapids	30	16	9	1,075 00
Commercial	..do	Marseilles	12	23	12	450 00
Rapp	Lee	Sublette	20	16	12	502 55
Crow	Livingston	Rooks Creek	8	14	7	285 00
Bruce	..do	..do	10	14	7	312 00
Eyman	..do	..do	8	14	7	325 00
Stick Branch	Madison	Fosterburg	12	16	13.5	547 50
Meyers	..do	Olive	30	16	14	1,143 00
McGauhey	..do	..do	25	14	13	975 00
Wiggitt Culvert	Mason	Mason City	Circular	Culvert	2' Dia.	Day labor
Babal	Montgomery	Hillsboro	12	14	13	307 40
Chamberlin	..do	..do	10	14	13	277 80
Grassell	..do	..do	4	14	13	159 16
Gruffs	..do	..do	6	14	12	176 21
McAdams	..do	..do	15	14	16	226 95
Miller	..do	..do	4	14	12	141 86
Church St	Moultrie	Marrow-bone	14	18	19.5	621 00
Leuthemeier	St. Clair	Smithton	24	16	13	112 00
Wiley	Stephenson	West Point	30	16	12	1,030 00
Lewis Ritzman	..do	Oneca	30	16	15.5	1,096 00
Coles Creek	Tazewell	Groveland	42	16	14	1,652 00
Carmi	White	Carmi	12	24	19	375 00
Brubaker	Whiteside	Garden Plain	20	16	16	825 00
Jackson Creek	Will	Manhattan	40	16	15.5	1,619 00
Thomas	Winnebago	Guilford	30	16	9	892 00
Latham Park	..do	Owen	42	18	13.5	1,525 00



Name	Cover	Township	Foundation						
Weimer	Henry	Geneseo	Pile	60	16	16	Reinforced concrete	1,147 00	1,026 35	2,173 35
McClellan Run	do	do	do	60	16	16.5	do	1,147 00	1,314 00	2,461 00
Colby	do	Cornwall	do	70	16	17	do	1,300 00	890 00	2,380 00
Henry	do	do	do	60	16	17	do	940 00	1,102 00	2,042 00
Decky	do	do	do	70	16	17	do	1,300 00	997 00	2,197 00
Broadbent	do	do	do	70	16	15	do	1,300 00	1,001 00	2,301 00
Klattenhoff	do	Colona	Rock	150	16	20.5	do	3,823 00	1,990 00	5,813 00
Rapp	do	Phenix	Pile	40	16	13	do	629 00	888 00	1,517 00
Dawson	Iroquois	Ash Grove	Earth	76.5	16	22	Wood	523 00	2,296 00	2,819 00
Davis	JoDaviess	Pleasant Valley	do	60	16	20	do			1,255 00
Brunner	do	do	Pile	75	14	16.5	Reinforced concrete			3,050 00
Williams	do	do	do	120	14	16.5	do	2,323 23	967 50	3,290 73
Andrew Swanson	Knox	Walnut Grove	Earth	70	14	21	do	997 00	1,175 24	2,172 24
Durflinger	Livingston	Rooks Creek	Rock	110	14	19	do			5,290 00
Ahlers	Madison	Olive	Earth	50	16	17	Wood	731 00	1,236 00	1,967 00
Seymour	Montgomery	Hillsboro	do	98	14	18	Reinforced concrete	633 00	1,302 88	1,935 88
Rhodes	Sangamon	Salisbury	do	28	14	14.5	do	940 00	910 00	1,850 00
Halligan	Whiteside	Prophetstown	Pile	50	16	17	do			2,045 00

TABLE NO. XVIII.

List of Concrete Bridges Built in 1909 Under the Supervision of Illinois Highway Commission.

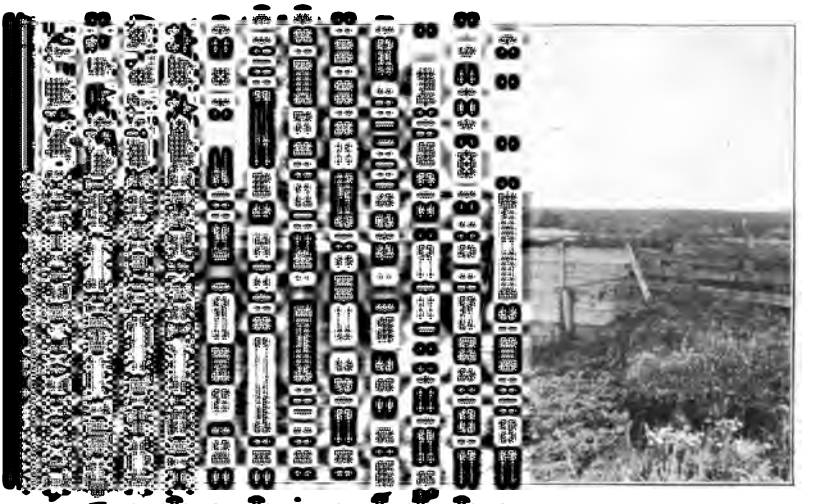
Name.	County.	Township.	Clear Opening.	Width Roadway.	Height Abutment.	Total Cost.
Phillips	Adams	Concord	20	16	14.5	$1,003 35
Heckel	..do	Melrose	8	20	14	775 00
Miller	Carroll	Fairhaven	20	16	14.5	1,200 00
Lutz	..do	..do	35	16	17.5	1,650 00
Geo. Schreiner	..do	Salem	12	16	9.5	520 00
Horner	Ford	Patton	20	16	9.0	*
Thompson	..do	..do	14	15	15	566 73
John Lawson	Henry	Western	16	16	11	782 00
Derrickson	..do	..do	16	16	12	809 00
McMinn	..do	..do	12	20	15	846 00
Lillis Creek	..do	Hanna	20	16	15.5	1,229 80
Schmoll	..do	Osco	24	16	14.5	1,204 00
Samuelson	..do	..do	10	16	9.0	600 00
Weidleim	..do	..do	10	16	9	915 00
Fuller	Iroquois	Belmont	20	16	13	950 73
Stockland	..do	Stockland	40	16	12	1,564 00
Culvert, No. 1	Jersey	English	3	20	4.5	*
Culvert, No. 2	..do	..do	3	20	4.5	*
Culvert, No. 3	..do	..do	4	20	4.5	*
Lamb	..do	Mississippi	20	16	13	*
Roper	JoDaviess	Warren	35	16	16	1,176 00
Slough	Jackson	DeSota	25	16	7	1,086 00
Fletcher	Kendall	Lisbon	6	30	5.5	*
Cliggett	..do	Oswego	40	16	16	620 00
Larson	Knox	Copley	16	16	10.5	779 00
West Avery	Lee	May	3–13	16	8.5	1,061 50
Creamery Creek	..do	..do	24	16	8.5	759 00
Cronkhite	Lake	Ela	12	18	13.5	651 00
Erusting	..do	..do	10	16	14	595 00
Funk	LaSalle	Otter Creek	14	16	9	420 66
Joe Hatter	..do	..do	14	16	9	387 74
Spencer	..do	..do	10	16	6	†
Freeman	..do	..do	12	16	8.5	419 70
Dutch Run	Madison	Omphghent	.....	.....	.....	841 00
Hartnett	..do	..do	35	16	16	839 00
Hamel	..do	Hamel	7	18	7	345 00
Shoeber	..do	Fort Russell	35	16	15	1,308 00
Stalhurt	..do	..do	12	14	.....	195 00
Feldman	..do	Edwardsville	14	16	22	1,511 16
Wright	Rock Island	Rural	14	16	10.5	850 00
Scotts	..do	..do	18	16	12.5	964 00
Number 6	St. Clair	Mascoutah	12	17	.....	275 00
Number 1	..do	..do	14	40	.....	275 00
Town Line	..do	..do	14	19	8.5	490 00
Phillip	..do	Smithton	14	16	11	488 53
Carr	..do	..do	14	16	12	464 19
Heberer Branch	..do	Freeburg	25	16	17	893 25
Paule	..do	..do	30	16	15.5	1,266 00
John Hillman	Tazewell	Elm Grove	7	18	6	478 00
Gainer	..do	Cincinnatti	30	14	13.5	1,080 00
Boyd	Whiteside	Mt. Pleasant	50	16	12.5	2,221 70
Drall Stassen	Will	Green Garden	30	16	11	952 44
Forked Creek	..do	..do	30	16	14	2,290 00
Mud Creek	..do	Manhattan	60	16	16	1,886 00
McNair	Winnebago	Winnebago	34	16	13	282 00
Edw. Peterson	..do	Cherry Valley	20	16	13	800 00
Ward	..do	..do	22	16	16	1,350 00
Stilwell	..do	Shirland	16	14	7.5	*
Hunt	..do	Guilford	26	16	12.5	985 00
White	Woodford	Linn	25	16	11.5	702 00
Shirer	..do	Roanoke	26	16	9.5	1,300 00
Dog	..do	Worth	20	16	18	960 80
Sornberger	..do	..do	22	16	14	760 00

*Day labor. †Not available.

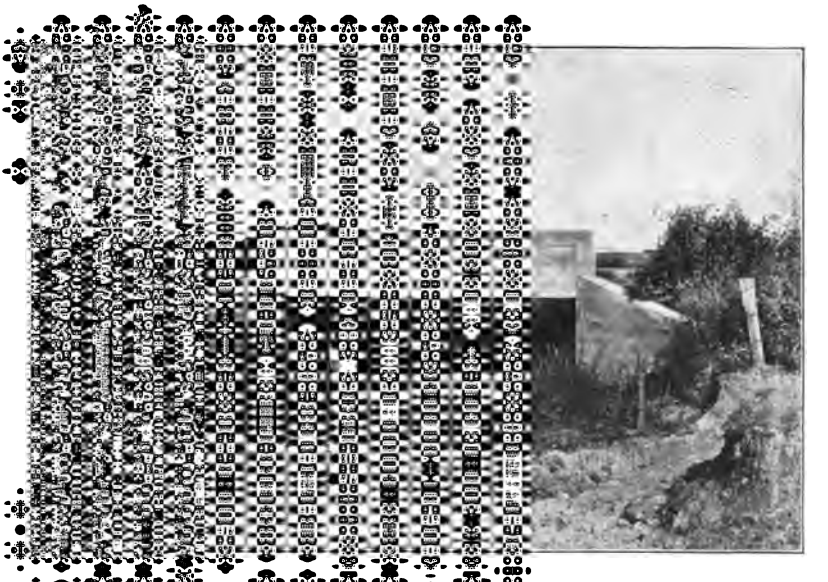
TABLE No. XIX.

Illinois Highway Commission—Cost Data on Concrete Abutments Built 1909.

Name.	Clear Opening.	Roadway.	Height of Abutments.	Total Concrete in cubic yards.	Total Steel in pounds.	Cost per cubic yard of concrete abutments.									Remarks.
						Cement.	Stone.	Sand.	Gravel.	Forms.	Steel in place.	Mixing placing concrete.	Excav. per cubic yard concrete.	Total cost per cubic yard of concrete.	
Rhodes	28	14	15	114.70	.....	1.41	.....	.....	2.56	0.58	.....	1.41	1.33	7.29	Plain concrete
Peters	30	16	15	84.72	.....	1.80	.....	.....	.....	0.36	.....	1.05	2.11	5.32	..do
McHealey	30	14	14	59.55	.....	1.40	.....	.....	.....	0.49	.....	2.09	2.14	6.11	..do
Hartnett	35	16	16	109.80	.....	1.21	2.76	0.22	.....	0.82	.....	1.23	1.32	7.56	..do
Rapp	40	16	13	79.75	.....	1.44	4.45	1.50	.....	1.47	.....	2.12	4.60	15.59	..do
Ahlers	50	16	17	125.54	.....	1.59	3.01	1.16	.....	0.59	.....	1.45	0.73	9.50	..do
Davis	60	16	20	114.10	.....	1.24	.....	0.99	1.59	0.71	.....	1.29	1.62	7.44	..do
Weimer	60	16	16	97.20	.....	0.98	3.50	0.87	.....	1.20	.....	1.75	3.47	11.77	..do
McClellan Run	60	16	.....	111.60	.....	1.00	3.36	0.50	0.71	1.64	.....	2.02	2.85	12.08	..do
Henry	60	16	17	109.50	.....	1.89	.....	.....	3.20	0.95	.....	0.92	2.49	9.45	..do
Broadbent	70	16	16	124.40	.....	1.64	.....	.....	3.22	0.71	.....	1.61	3.00	10.18	..do
Rush Creek	70	14	17	40.00	.....	3.40	3.99	0.75	.....	0.90	.....	0.90	3.35	13.29	..do
Colby	70	16	17	108.80	.....	1.94	.....	.....	3.41	0.70	.....	1.09	2.51	9.65	..do
Dickey	70	16	17	108.80	.....	1.66	.....	.....	4.32	0.71	.....	1.20	2.45	10.34	..do
Bruner	75	14	18	160.40	.....	1.41	.....	1.51	1.32	0.88	.....	1.64	1.98	8.74	..do
Dawson	76	16	22	262.40	.....	1.31	.....	.....	1.80	0.88	.....	1.17	1.39	6.55	..do
Seymour	98	14	17.5	215.80	.....	2.03	.....	.....	0.93	1.09	.....	1.05	3.08	8.18	..do
Durflinger	110	14	20	249.30	.....	1.78	1.88	1.20	.....	1.13	.....	1.07	0.90	7.96	..do
Williams	120	14	32	144.40	.....	1.75	.....	1.53	1.49	0.68	.....	1.33	1.64	8.42	..do
Waynet	140	18	27	194.40	13,283	1.46	.....	.....	0.65	2.37	1.54	1.22	5.30	12.54	Reinforced concrete
Klottenhoff	150	16	20.5	137.70	9,189	1.15	1.68	0.62	0.65	1.87	1.16	1.51	2.09	10.73	..do



[illegible] County, before reconstruction.



[illegible] County. Span, 20 feet; road-
[illegible], contractor. Completed in
[illegible] Commission.

Some Cost Data for Reinforced Concrete Highway Bridges.

Probably a majority of the bridge sites in Illinois has a low clearance or headroom. Foundations usually must rest on earth; in many instances it becomes necessary to drive piles, in order to give sufficient bearing. It is exceptional that the rock approaches near enough to the surface to found the abutments on it. It became necesary to adopt such a design as would give a maximum clearance and waterway, at the same time adapted to an earth foundation. To meet these conditions, therefore, a through girder concrete bridge was developed; that is, a bridge supported by two girders to which the floor is hung; in this way using a minimum of clearance and giving a maximum waterway for a given distance between abutments.

This type of bridge has its limitations. A bridge supported by two girders to which the floor is hung is limited as to width of roadway for a given span and also as to length of span. It was found, however, that where the roadway is not required to be over 18 or 20 feet, this type of bridge proved economical up to spans 40 to 60 feet, as compared with arches having the same area of waterway and designed to carry the same loads. While the tops of the girder bridges are heavier than would be required for arches, yet, owing to the fact that there is no horizontal thrust developed, the abutments do not need to be as extended or made as heavy. There is, therefore, less concrete for the width of roadway named, taking the abutments and superstructure as a whole, in the through girder design than arches, giving the same area of waterway and capable of supporting the same loads. In appearance the girder bridges are massive and well adapted to their apparent purpose, having in general a not unpleasing outline.

Perhaps the greatest advantage possessed by the girder type over the arch is the slight damage, if any at all occurs, to the former due to uneven settlement of the abutments as is very apt to occur in many of the soil conditions encountered; while, on the other hand, such displacement of the abutments of an arch is extremely hazardous to its stability. These are the reasons for designing nearly all concrete bridges of the through girder type, not that this type is necessarily to be preferred in all locations, or under all conditions, but merely that it has proven most economical in nearly all instances in the practice of the commission.

Method of Design.

The formulæ used in the design of these bridges have been reduced from the general formulæ developed by Prof. A. N. Talbot and others. The form in which they are used is that most convenient for purposes of bridge design. The first fact to determine is the stress to be allowed in the concrete and the steel, which, when once fixed, determines the percentage of steel reinforcement. The compression allowed in the concrete has been taken at 750 pounds per square inch for concrete 60 days old with a corresponding stress in the steel in tension of 16,000 pounds per square inch. This corresponds to practically 1 per cent reinforcement.

To compute the dimensions of a girder to withstand a given bending moment, M, where b is the breadth and d the depth, from the top of the beam to the center of gravity of the steel, using the above stresses in the concrete and steel,

$$M=0.833 \times 16{,}000\ bd^2 \times 0.01.$$

Usually b is assumed and d is to be found then this reduces to the simple form

$$d=\sqrt{\frac{M}{136b}}$$

For computing the depth of T beams, see Figure No. 10, the width of the flange b is assumed and the depth is then computed by the above formulæ but always making the depth of the flange not less than one-fourth of the value found for d.

To provide against diagonal tension in the webs of beams, U stirrups are used where the shear in the concrete exceeds 30 pounds per square inch. The amount of steel to be provided is found thus: Let V be the total shear in a given section of the beam. The steel stressed at 16,000 pounds per square inch, necessary to carry six-tenths, V is distributed along the beam for a distance equal to the height of the beam =d. For example, if V=200,000 pounds, 0.6 V=120,000 pounds, which would require 12.5 square inches of steel. If the value d of the beam is 60 inches, there are required 12.5 square inches of steel for 60 inches, or 0.208 square inches of steel per inch of girder. A U-shape stirrup of ¾-inch square section rods would have in both legs 1.12 square inches of steel, which divided by 0.208 will give the spacing for the U stirrups,

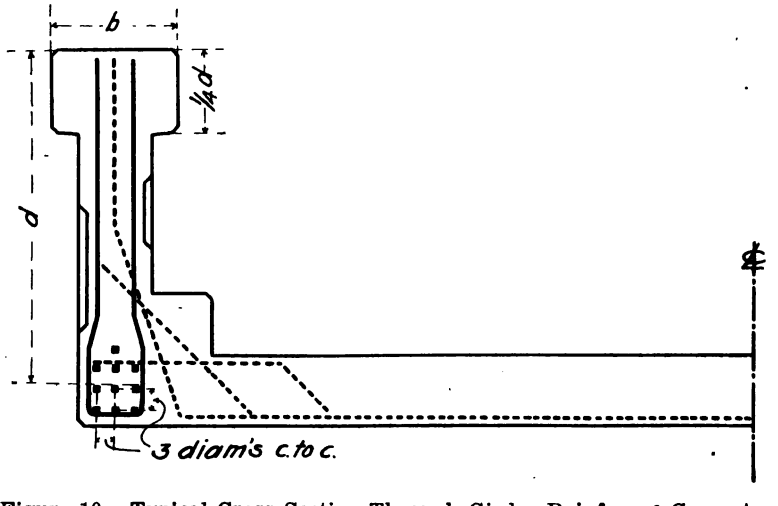
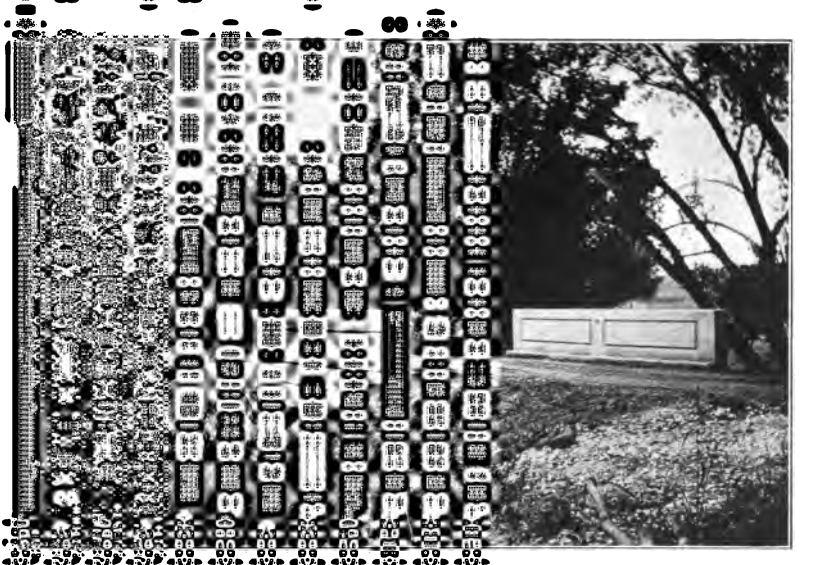
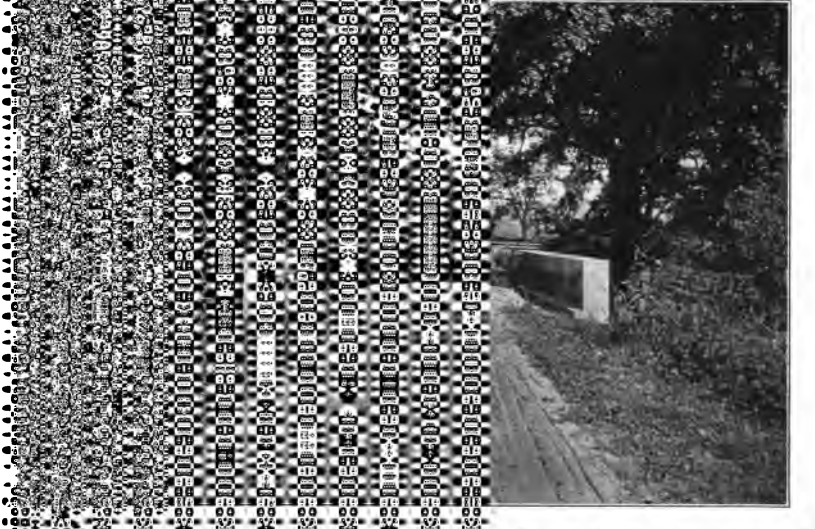


Figure 10. Typical Cross Section Through Girder Reinforced Concrete Bridge.

which in this case would be about 5 inches for the first 60 inches along the beam. In the next section, a new value for the shear would be com-



Concrete arch bridge over Weasel Creek, Township, Henry County. Span, 16 [illegible] cost, $600.00. Patch & Swords, [illegible] by the Highway Commission.



[illegible] St. Clair County. Span, 24 [illegible] Brothers, contractors. Cost

puted and the rods and stirrups spaced accordingly, as the shear is usually computed for sections which are arbitrarily spaced along the beam equal to its depth d.

The thickness of the web of the T beams should be investigated for horizontal shear. Usually, however, the governing factor in determining the thickness of the web is the space required for the reinforcing rods.

The loads for all concrete bridges are taken thus: Dead loads concrete at 144 pounds per cubic foot, crushed stone at 90 pounds, and earth at 100 pounds per cubic foot. Live loads are uniform 125 pounds per square foot and concentrated live load of 24 tons distributed on two axles, 10 feet apart, 8 tons on the front and 16 on the rear axle. The load is taken as applied over a width of 12 feet. The moment for both uniform and concentrated live loads is computed, and the greater combined with the dead load moment to determine the girder and floor dimensions.

Character of Concrete.

The character of concrete employed in the bridges under discussion is a factor governing the cost. It will be noted that the specifications appended hereto provide for a 1x2½x4 mixture for reinforced work. This proportion was determined upon after considerable experience with a 1x2½x5 mixture, which did not secure an altogether satisfactory finish. As much of the surface of the concrete is exposed in bridges, a smooth, close-grained surface is particularly desirable. If a smooth finish is to be secured in concrete work, it is necessary, first, that the forms be carefully made and kept true to alignment; second, that the concrete shall contain sufficient mortar to more than fill all voids in the stone. This is not secured satisfactorily when the proportion of mortar to the stone is one-half, as is the case in a 1x2x4, 1x2½x5, or 1x3x6 concrete. The specifications were therefore changed so that the proportion of mortar to the stone varies with different classes of concrete, according to the purpose for which it is to be used. In reinforced work we have endeavored to use a concrete which will have a volume of mortar about equal to 60 per cent of the volume of the stone. Such an amount of mortar is necessary where the concrete must be placed around the reinforcing rods and molded closely against the forms, which are not a great distance apart. Under these conditions, if honeycombed effect is to be avoided with the workmanship ordinarily secured, concrete with more than 50 per cent mortar should be used. In gravel concrete, the amount of cement to be used is proportioned according to the amount of sand; the amount of sand that may be allowed depends upon the voids in the stone, mortar being supplied to at least 60 per cent of the total volume of the stone for use in reinforced work. Stone for this class of construction moreover should not exceed one inch in size if it is to be satisfactorily placed about the reinforcement.

While the specifications do not call for any particular kind of reinforcement, other than it must have some means of rigid mechanical bond at frequent intervals, as a matter of fact nearly all the work so far done has employed square, twisted rods.

Forms.

The specifications and drawings provide for rigid forms. Particular attention is paid to the bents supporting the structure during construction. It is evident that great care must be exercised to prevent any settlement of the girders while the concrete is hardening, when it is borne in mind that, for spans of 40 to 60 feet, the girders and floor weigh six to seven tons per running foot. The plans for the longer spans require that the bents supporting the forms shall rest on piles firmly embedded, unless the stream bed is of such a character to make this unnecessary. But such a condition is the exception. In a number of instances the contractor has put in concrete footings flush with the bottom of the stream bed and placed the bents on them.

Discussion of Data.

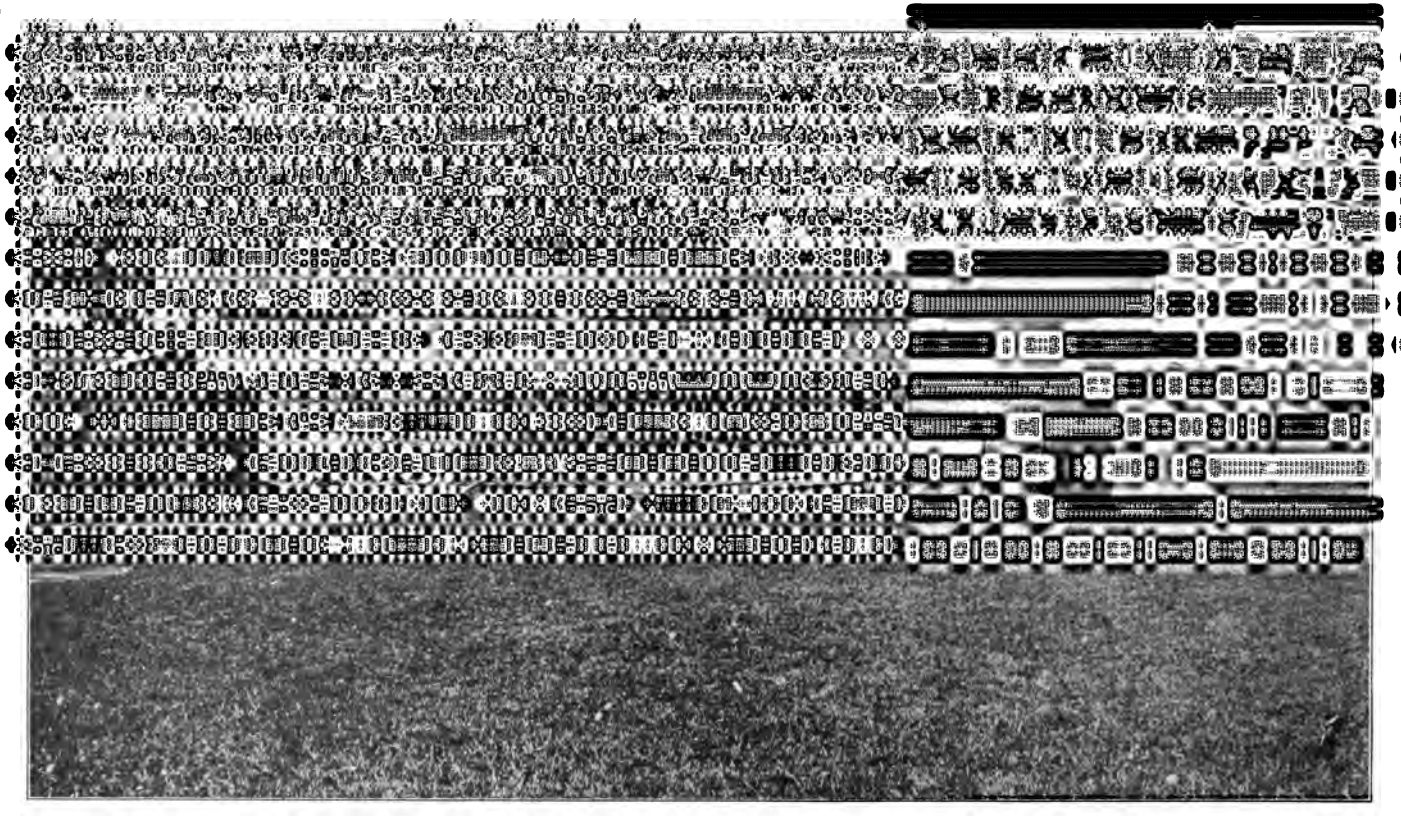
The cost data here given were collected by the resident inspectors in the employ of the State Highway Commission, who keep a daily record of all labor for each portion of the work, together with the quantity and cost of all materials. The cost of materials was generally obtained from bills, and the prices secured from the contractors. The amounts given, therefore, do not contain any allowance for the office maintenance of a contractor's organization, no traveling expenses of the contractor, nor any allowance for profit. Also, in the cost for forms, deductions have been made for the actual salvage on all lumber, but as most of the work was in the country, there was little opportunity for the contractor to dispose of this material to advantage.

All the data presented are from work done during 1909. There were a number of other jobs handled, but sufficient data were not collected on them to embody in this table. The various bridges have been arranged in order of length of span, and all data available collected together in tabular form.

In a number of instances it proved that the actual cost to the contractor was greater than his contract price. It is perhaps well to consider what were some of the causes that produced such results. First, incompetency on the part of the foreman is the most usual cause of loss to the contractor; or, if not an actual loss, at least a great reduction in the profit reasonably to be expected. The loss usually occurred in the foundation portion of the work. Sufficient protection would not be taken to prevent a cave-in, with the result that a large amount of extra material would be shoveled from the bottom of the trench to the top. Good sheeting well braced is usually required.

In a few instances, increased cost to the contractor was occasioned by doing part of the work twice, owing to the use at first of poor material which had to be replaced. In some instances foremen were found who could scarcely read the plans, and, except for the assistance of the inspector, would have had a sorry time of it. Others had no control over their men, who loafed or worked much as they pleased.

It is evident that under such conditions no profits could be expected. Probably all the contractors intended to send competent men, and possi-



Mud Creek bridge, Manhattan Township, Will County, as reconstructed. Span, 60 feet; roadway, 16 feet. Cost, $1,893.00. Julius Pfaff, contractor. Completed in 1909. This bridge is rust proof, flood proof and fire proof. When completed, was the longest bridge of this type in Illinois.

bly sent as good as they could get, but, when good men are scarce, it is not to be expected that they will be attracted by a poor salary. An adequate wage will usually secure competent foremen.

Money was also lost on some jobs through ignorance on the part of the contractor in making his bid. In a few cases contracts were taken at prices 30 per cent to 40 per cent below the estimate. The bids from experienced contractors at the same letting would be for a rational sum. There should be some way by which a manifestly too low bid for public bridges, or other public works for that matter, could be rejected as readily as too high bids. To accept a bid too low is unfair to the reasonable bidder; takes unfair advantage of the contractor making the low bid; and, by putting a premium on poor work, is unfair to the taxpayers.

The cost data here presented should afford some guide in making bids on similar work. Owing to the great variance in conditions it is impossible to state what price should be secured for reinforced concrete bridges to insure in a given instance a reasonable profit. It will be noticed that the cost of cement in a cubic yard of concrete varied from $2.35 to $1.25; for stone, from $3.23 to $1.30; for sand, from $1.47 to 32 cents, excluding gravel concrete; for gravel, from $2.43 to 70 cents; for forms, from $3.95 to 83 cents; for placing steel, from $3.10 to 80 cents; for mixing and placing concrete, $2.72 to 72 cents; for excavation per cubic yard of concrete, $3.91 to 21 cents, and that the total cost per cubic yard of concrete varies from $17.51 to $6.54.

From such a wide variation, it becomes apparent that averages will mean but little to estimate the cost of a particular job. One of the most uncertain features of this class of work is the cost of excavation. It would probably be a more exact method of distribution if the cost per cubic yard for the foundation were given separately from the superstructure, and charge all of the excavation against the concrete going into the foundation. This, however, was practically impossible from the data at hand, but the amount of concrete in each portion of the structure is given, which will assist in determining the proper distribution of the cost.

It generally may be said that, unless materials were exceptionally near at hand and obtained consequently at much lower cost than usual, there has been little profit to the contractor in this class of work at a price much less than $10.00 to $12.00 per cubic yard. It does not follow, however, that all the work let at a less figure has been at a loss to the contractor, or that all jobs let at a higher figure have been at a profit, as some of the work let at a good figure was so badly managed as to cut all the profits and cause an actual loss to the contractor. Inasmuch as the data here given include both well and badly managed work, this fact should be borne in mind in attempting to draw any too exact conclusions. But, if used with judgment, it is believed that these data should be of considerable help to engineers and contractors in making estimates on similar work.

Table No. XX gives the detailed cost data of a number of reinforced concrete bridges built in 1909.

TABLE No. XX.

Illinois Highway Commission—Cost Data of Reinforced Concrete Bridges Built 1909.

Name.	Clear Opening.	Roadway.	Height of Abutments.	Substructure.		Superstructure.		Total Concrete in cubic yards.	Total Steel in Pounds.	Cost Per Cubic Yard.								
				Concrete in cubic yard	Steel in Pounds.	Concrete in cubic yards	Steel in Pounds.			Cement.	Stone.	Sand.	Gravel.	Forms.	Steel in Place.	Mixing placing concrete.	Excav. per cubic yard concrete.	Total cost per cubic yard concrete.
Hamel	7'	18'	7'	22.71	850	6.91	670	29.62	1,520	1.35	2.44	0.61	.....	1.50	1.16	1.61	1.28	9.95
Heckle*	8	20	14	61.74	2,927	7.42	741	69.16	3,668	1.81	0.77	0.80	.....	1.71	0.81	1.56	0.41	7.87
Erusting	10	16	14	46.55	1,652	11.45	1,041	58.00	2,693	1.51	.....	1.06	2.05	1.59	0.80	1.16	1.16	9.33
Stahlhurtt	12	14	.....	.....	.....	.....	.....	16.00	1,800	1.30	3.23	0.32	.....	2.07	2.41	0.95	.....	10.28
Geo. Schreiner	12	16	9.5	35.60	1,290	11.85	1,223	47.45	2,513	1.85	.....	.....	1.19	2.16	1.53	1.23	1.09	9.05
Cronkhite	12	18	13.5	52.87	1,926	17.13	1,554	70.00	3,480	1.46	.....	0.86	1.72	2.39	0.84	1.46	2.16	10.89
West Avery	13	16	8.5	37.60	.....	34.20	4,120	71.80	4,120	2.25	.....	.....	1.00	1.70	1.28	0.80	1.09	8.12
Carr	14	16	12	33.28	1,027	13.31	1,924	46.59	2,951	1.74	2.61	1.10	.....	1.37	1.13	1.77	0.50	10.22
Thompson	14	16	15	27.07	724	14.93	1,647	42.00	2,371	2.05	2.71	1.46	.....	2.50	1.26	1.81	1.70	13.50
Town Line	14	19	8.5	34.74	1,893	17.38	1,938	54.85	3,830	1.34	3.06	0.75	.....	1.01	1.72	0.84	1.06	9.80
Joe Hatter	14	16	9	23.74	700	14.93	1,647	38.67	2,347	1.56	1.64	0.72	.....	1.44	1.44	2.05	1.00	9.85
Feldmann	14	16	22	139.00	10,633	15.44	1,688	154.44	12,321	1.48	1.99	0.65	.....	2.38	1.89	1.95	3.91	14.25
Phillips	14	16	11	29.82	790	13.31	1,926	43.13	2,716	1.74	2.78	1.23	.....	1.58	1.24	1.93	0.81	11.31
Funk	14	16	9	26.96	879	14.93	1,647	41.89	2,526	1.63	1.66	0.61	.....	2.16	1.43	1.16	1.07	9.72
Derickson	16	16	12	38.84	1,400	21.28	2,454	60.12	3,854	1.56	2.45	1.09	.....	2.82	1.51	1.60	3.49	14.52
John Lawson	16	16	11	37.52	1,546	21.28	2,454	58.80	4,000	1.61	2.50	1.11	.....	2.47	1.25	1.09	1.69	11.72
Stillwell	16	16	7.5	30.35	546	21.28	2,454	51.63	3,000	1.30	1.30	0.35	.....	0.98	1.34	0.83	0.43	6.54
Culvert, No. 1-6	17-12	.....	.....	.....	.....	.....	.....	48.37	6,307	1.72	.....	0.73	1.83	1.36	2.64	0.98	0.47	9.73
Scotts	18	16	12.5	.....	.....	.....	.....	84.25	6,050	1.74	1.92	0.29	1.20	2.20	1.44	1.50	0.95	11.24
Edw. Peterson	20	16	15	92.21	1,845	25.12	3,910	117.33	5,755	1.44	.....	.....	0.85	1.36	1.04	1.36	3.30	9.35

* Stone furnished free to contractor except freight and hauling.

Illinois Highway Commission—Cost Data of Reinforced Concrete Bridges Built 1909—Continued.

Name.	Clear Opening.	Roadway.	Height of Abutments.	Substructure.		Superstructure.		Total Concrete in cubic yards.	Total Steel in Pounds.	Cost Per Cubic Yard.								
				Concrete in cubic yard	Steel in Pounds.	Concrete in cubic yards	Steel in Pounds.			Cement.	Stone.	Sand.	Gravel.	Forms.	Steel in Place.	Mixing placing concrete.	Excav. per cubic yard concrete.	Total cost per cubic yard concrete.
Lamb	20′	16′	13′	56.79	1,428	25.12	3,910	81.91	5,338	1.87	0.88	0.40	0.88	1.74	1.37	1.27	1.45	9.86
Fuller	20	16	13	60.05	1,955	25.12	3,910	85.17	5,865	1.68	1.75	0.28	0.70	1.51	1.57	1.16	1.18	9.83
Dog Bridge	20	16	18	91.68	4,325	25.12	3,910	116.80	8,235	2.24	.....	.....	0.96	1.37	1.52	0.90	1.33	8.32
Lillis Creek	20	16	15.5	64.97	2,760	25.12	3.910	90.09	6,670	2.20	1.93	0.05	2.42	3.95	1.61	2.72	2.63	17.51
Phillips	20	16	14.5	39.55	1,501	25.12	3,910	64.67	5,411	1.25	.....	.....	1.96	0.83	1.73	0.86	0.59	7.22
Sornburger	22	16	14	60.35	2,484	30.89	5,066	91.24	7,490	1.96	.....	.....	1.65	2.37	2.24	1.07	1.00	10.29
Creamery Creek	24	16	8.5	32.10	1,194	30.89	5,006	62.99	6,200	2.31	.....	.....	1.91	1.97	1.95	0.72	1.52	10.38
White	25	16	11.5	38.35	1,355	26.18	5,416	64.53	6,771	1.62	0.49	.....	1.65	2.72	2.48	2.07	1.67	12.70
Slough	25	16	7	60.12	1,936	26.18	5,416	86.30	7,352	1.45	2.12	0.94	.....	2.31	2.75	0.90	0.21	10.68
McCauhey	25	14	13	44.62	1,799	24.20	5,085	68.82	6,884	1.87	2.97	1.47	.....	2.57	1.90	1.14	1.13	13.05
Drl.-Stassen	30	16	11	51.62	1,849	41.61	6,786	93.23	8,635	1.43	1.83	1.24	.....	1.84	2.43	1.76	1.85	12.38
McNair	34	16	13	59.30	2,290	62.70	11,044	122.00	13,334	1.76	.....	.....	1.43	2.25	2.08	0.96	1.12	9.60
Schoeber	35	16	15	71.40	2,756	52.40	8,956	123.80	11,712	1.90	1.45	0.14	0.72	1.34	2.23	1.02	0.73	9.33
Roper	35	16	10	57.40	2,536	52.40	8,956	109.80	11,492	1.85	0.90	1.41	2.06	1.41	2.39	1.44	1.64	13.10
Stockland	40	16	12	71.60	2,213	63.60	13,784	135.20	15,997	1.47	1.49	0.47	.....	2.60	3.10	2.01	2.57	13.71
Cligett	40	16	16	64.23	2,271	62.35	10,925	126.58	13,196	1.70	.....	0.70	2.43	2.15	2.01	1.55	2.56	13.10
Boyd	50	16	15	73.75	2,328	65.00	14,172	138.75	16,500	2.35	.....	.....	1.60	3.24	2.32	1.53	2.02	13.08
Mud Creek	60	16	16	109.00	3,620	97.07	20,338	206.07	23,958	1.31	1.50	1.11	.....	1.62	2.43	1.14	2.33	11.43

Some data were also obtained showing the detailed cost of concrete abutments for steel bridges. Table No. XIX gives the detailed cost data on concrete abutments. Table No. XVII gives a description and the total cost of steel bridges built in 1909. Table XVIII gives a description and total cost of concrete bridges built in 1909. Table XV gives a description and total cost of steel bridges built in 1908. Table XVI gives a description and total cost of concrete bridges built in 1908. Table XIV gives a summary of the bridge work handled by the commission for the years of 1906, 1907, 1908 and 1909.

Specifications for Concrete Masonry.

Plans and Dimensions.

All concrete masonry shall be built to the dimensions as shown on the plans furnished or approved by the engineer and which are a part of these specifications.

The concrete shall be of the character as indicated on the plans or as provided for in these specifications and shall be built by the contractor in accordance therewith.

Concrete.

Cement—Some standard brand of Portland cement shall be used which has been in practical use on public works for not less than five years and shall have proved satisfactory therein. No brand of cement shall be used which the engineer deems unfit for the work nor shall any cement be used which fails to give satisfactory results according to the standard methods of testing as provided by the American Society for Testing Materials. The contractor shall provide sufficient means to protect the cement against dampness, and no cement shall be used which has become caked.

The contractor shall notify the engineer in writing what brand or brands he intends to use and before ordering the cement shall receive the written approval of the engineer as to the brand selected. It is understood that such approval merely covers the selection of the brand; that the cement itself may be rejected if it fails to meet the requirements herein specified.

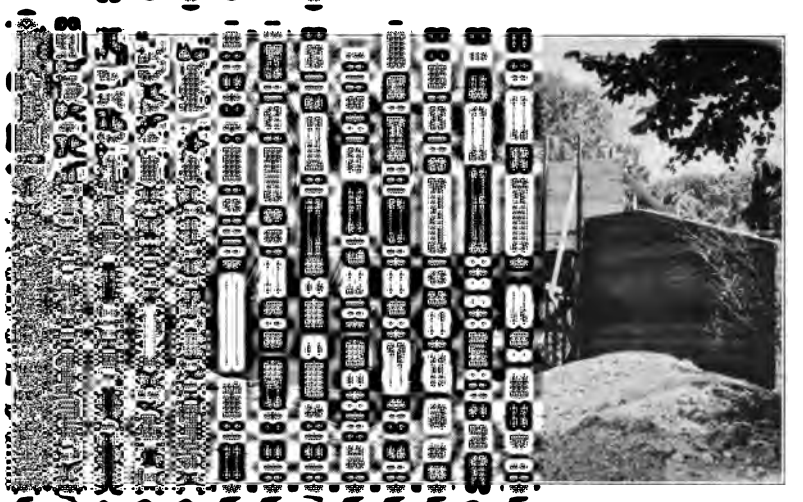
Sand—Sand shall consist of coarse, clean, sharp quartz grains and shall not contain over two per cent of clay or loam.

Stone—Stone used for concrete work shall be broken to the sizes herein specified, and shall consist of clean, sound material. No weathered or disintegrated material shall be used.

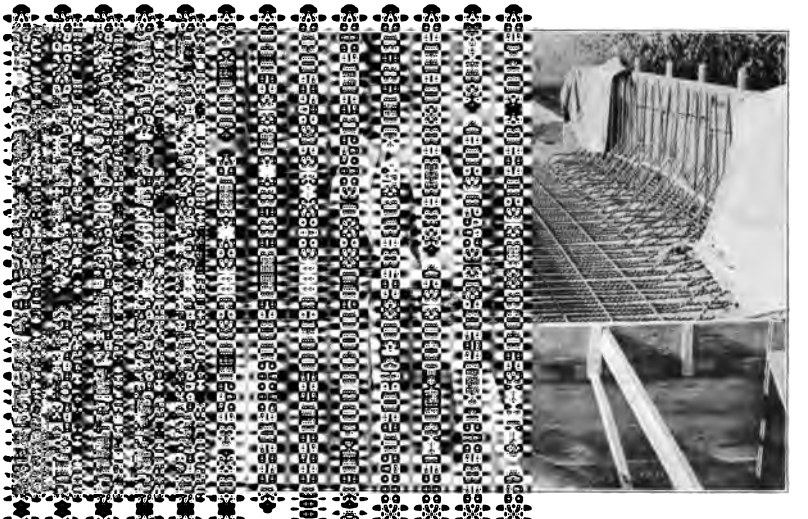
Water—Clean water shall be used in mixing and building concrete.

Class X, A and B—Unless otherwise specially indicated on the plans, there will be three classes of concrete known as Class X, Class A and Class B.

Class X concrete shall consist of 1 part cement, 2 parts sand and 3½ parts rock broken to pieces which will be retained on a ⅜-inch screen and which will pass a 1-inch ring.



Reinforced concrete arch under the supervision of the [illegible]. The arch is completed and falsework and [illegible] are covered with [illegible] pre concrete.



[illegible] arch under the supervision of the [illegible] and outside girder forms [illegible].

Class A concrete shall consist of 1 part cement, 2½ parts sand and 4 parts rock broken to pieces which will be retained on a ⅜-inch screen and which will pass a 1 inch ring.

Class B concrete shall consist of 1 part cement, 3 parts sand, and 5 parts rock broken to pieces which will be retained on a ¾-inch screen and which will pass a 2½ inch ring.

Gravel—Gravel may be used in the place of broken stone and sand for concrete and when so used shall conform to the following requirements:

Gravel used for concrete shall consist of clean, hard and sound stones, pebbles and sand, having a reasonably uniform gradation from the coarsest material allowable for the work specified to fine sand, and shall be used and proportioned in the following manner.

In proportioning gravel concrete, frequent tests will be made to determine the proportion of sand to stone. For Class X and Class A gravel concrete all material which passes a ¼-inch screen will be considered sand, and all material which is retained on a ¼-inch screen and passes a 1-inch screen will be considered stone. For Class B gravel concrete, all material which passes a ¼-inch screen will be considered sand and all material which is retained on a ¼-inch screen and passes a 2½-inch screen will be considered stone. For any of the above named classes of concrete, should the volume of sand so found be less than 60 per cent of the volume of stone, sufficient sand shall be added to bring up the proportion of sand to stone to 60 per cent. Should the volume of sand be more than 60 per cent of the volume of stone, sufficient stone shall be added to reduce the proportion of sand to stone to 60 per cent or sufficient cement shall be added so that the volume of cement to sand shall be for Class X concrete, as 1 to 2; for Class A concrete, as 1 to 2½, and for Class B concrete, as 1 to 3. In any case the proportion of cement to sand shall be as stated for the various classes of concrete.

Moulding—Moulding having ¾-inch or 1-inch sides shall be used in all exposed corners. The surface of such moulding in contact with the concrete, may be rounded to a uniform radius or may be flat. In the latter case the resulting angles between adjacent surfaces in the finished concrete shall be equal.

Bevelled Faces—Forms shall be given a bevel of 1 inch to 1 foot, wherever projections of the concrete, such as copings, floor-beams, etc., would otherwise cause binding upon removal of the forms. The pitch shall be so arranged as to increase the thickness of copings, floor-beams, etc., at the base and the narrowest parts of such projections shall have dimensions not less than as shown on the plans.

Mixing—Concrete may be mixed by machinery or by hand. If by machinery, the mixing shall be done in a batch mixer, approved by the engineer. If by hand, the sand and cement shall be first mixed dry in proper proportions until the mixture shows a uniform color; to the mixture thus prepared shall be added the proper proportion of broken rock which has been previously drenched with water, and the whole shall be mixed until every piece of the rock is coated with mortar. Sufficient water shall be used in mixing the concrete so that the water will readily flush to the surface with very light tamping or troweling.

Concrete shall be mixed in such quantities that a batch can be placed in the work within forty-five minutes from the time of mixing. No concrete shall be used which has taken an initial set and which requires retempering.

If mixed by hand, all mortar and concrete shall be mixed on a tight board or other platform approved by the engineer.

Placing—All concrete shall be carefully deposited in place in such a manner that the stone and mortar are not separated.

As fast as concrete is put in place, it shall be thoroughly tamped and the portion next to the forms shall be troweled by using a spade or other means to bring the mortar in thorough contact with the forms.

Concrete shall be placed in continuous horizontal layers in walls and girders. In floors the concrete shall be placed for the full thickness and the construction of the floor carried along in this manner.

Forms—The contractor shall provide all necessary material and means for building the necessary forms for all concrete masonry.

All forms shall be constructed as to be held rigidly in place. If at any point of the work, after the concrete has been placed, the forms show signs of bulging or sagging, that portion of the concrete shall be immediately removed on notice by the inspector, and the forms shall be properly supported. The amount of concrete to be removed shall be determined by the inspector, and no extra allowance shall be made to the contractor for such work.

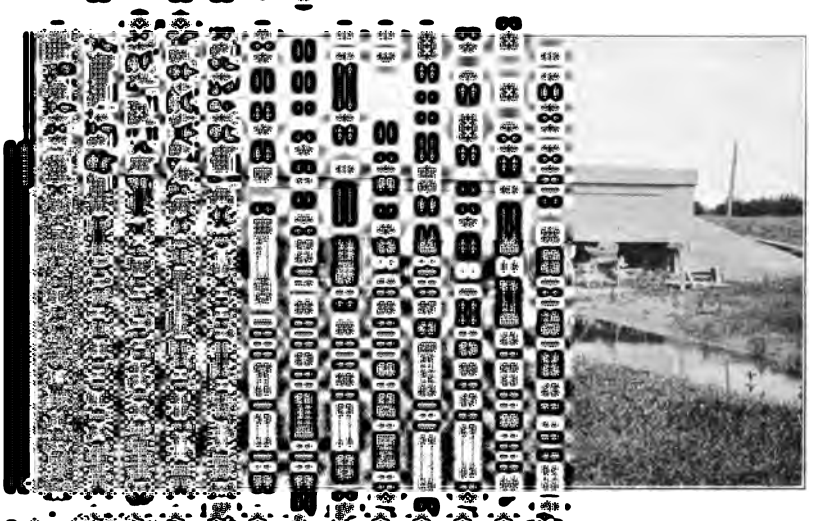
All forms are to remain in place until in the opinion of the engineer it is safe to remove them.

It is understood that all prices for concrete masonry shall include furnishing all materials, necessary forms and false work, tools, machinery, labor, excavation and incidental work necessary properly to place the concrete.

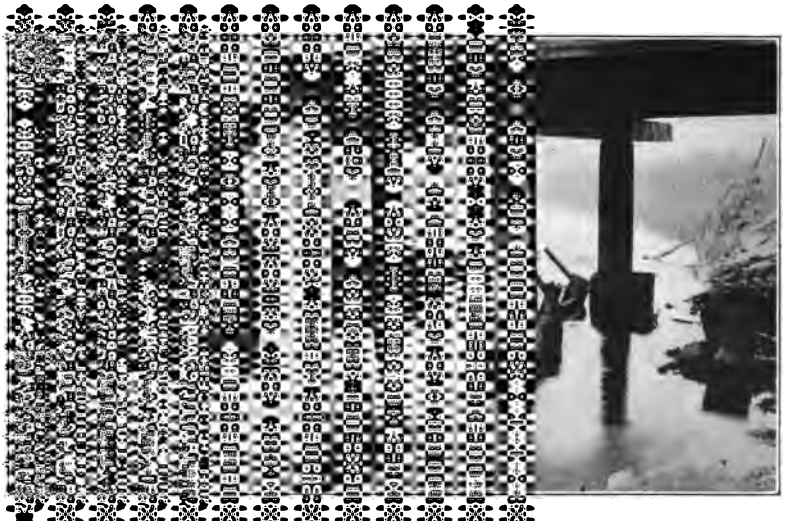
Joints—If the work is interrupted, so that the last layer of concrete is deposited more than twenty-four hours before the next can be laid, and there are no reinforcing rods projecting, a timber 8 inches wide shall be laid the entire length of the course and shall be bedded for at least 4 inches in the concrete and allowed to remain until the concrete has set. When the work of laying concrete is again resumed, the timber shall be removed, and the surface of the concrete shall be cleaned and washed with neat cement paste, and then the new concrete shall be placed immediately upon the surface thus prepared.

Finish—The forms covering what will be the exposed face of the concrete masonry shall be removed as soon as the engineer decides that it is safe to do so, and all crevices neatly filled with a stiff 1 to 2 cement mortar thorougly rammed into place. The whole surface is then to receive a wash of neat cement paste, the same to be kept moist and protected from wind and sun to prevent drying until the cement is thoroughly set. The cement wash shall be put on the last thing at night unless other treatment is specified.

All exposed faces shall be so finished that they will have a smooth and neat appearance.



[illegible] under the supervision of the [illegible], forms removed from [illegible]



[illegible] under the supervision of the [illegible] used to support a 60 [illegible] were used to support

All top surfaces such as the top of retaining walls, abutments, girders, floors, etc., shall be treated by tamping and troweling in such a manner as to flush the mortar to the surface and provide a smooth, even surface, free from pits or porous places.

If necessary to secure such a surface a thin layer of mortar consisting of one part of cement to two parts of sand shall be applied evenly and troweled smooth before the concrete has set.

The exposed surfaces of concrete copings, side rails, and arch rings where so indicated on the drawings, shall be bush-hammered so as to give a roughened surface of uniform appearance, and if required by the engineer shall be washed with a paste or neat cement.

Abutments and Wing Walls—Unless otherwise specified, Class B concrete shall be used in all plain concrete abutments and wing walls, and shall also be used elsewhere as may be provided for on the plans or by the written directions of the engineer.

Reinforced Concrete—All reinforced concrete, and all plain concrete masonry measuring less than six inches in thickness, shall be made of Class A concrete unless otherwise shown on the drawings or directed in writing by the engineer.

Steel for Reinforced Concrete—Unless otherwise shown on the drawings, all steel for reinforcement in concrete shall consist of bars which shall be twisted square section bars or which shall otherwise provide for some means of rigid mechanical bond at frequent intervals.

Plain bars will be permitted only where shown on the drawings, or as may be specially directed in writing by the engineer.

The size of all steel reinforcement as indicated on the drawings is the side of a square equivalent to the required net section.

The steel bars shall be distributed in the concrete in the exact positions and have the net sectional area provided in the drawings.

Unless otherwise specified, all steel for reinforced concrete shall be medium steel with an elastic limit of not less than 32,000 lbs. per square inch. Steel bars shall withstand bending cold with a radius equal to twice their diameter through 180 degrees without fracture.

Before steel is placed in the concrete, it shall be free from grease, dirt or rust, and the contractor shall provide means on the work for properly cleaning the steel.

Special care shall be exercised to insure thorough contact of the concrete with every portion of the surface of the steel reinforcement.

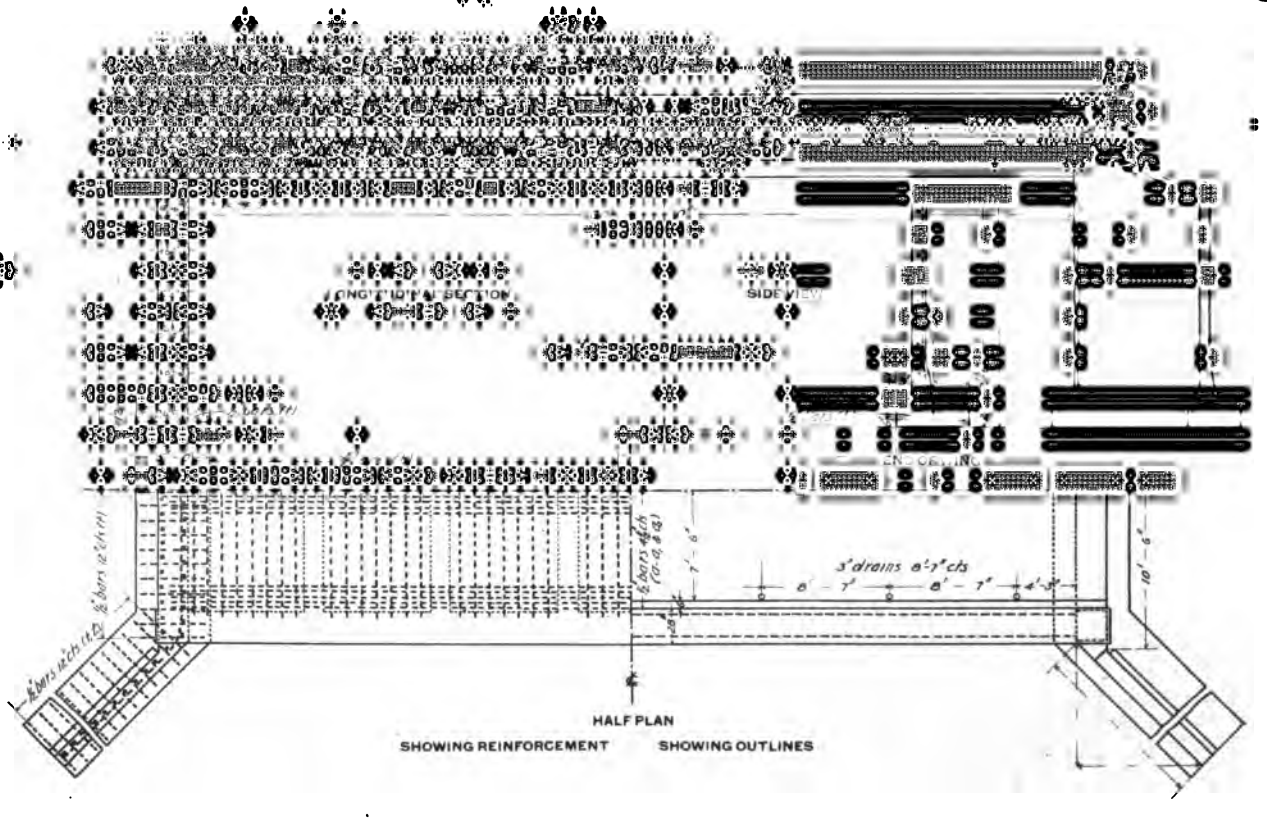
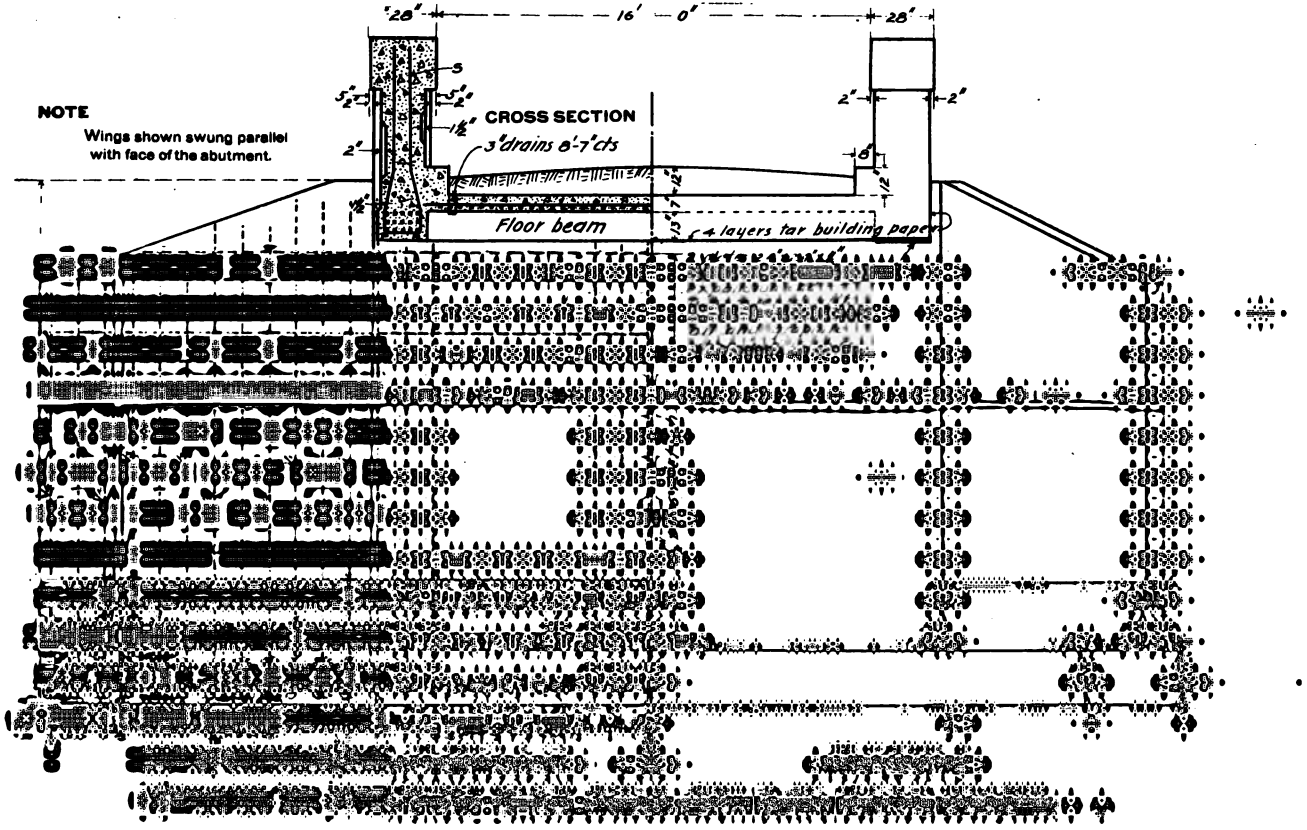


Figure No. 11. Longitudinal Section and Plan, 60 foot reinforced concrete girder bridge; 16 foot roadway.


NOTE
Wings shown swung parallel with face of the abutment.
CROSS SECTION
3"drains 8'-7"cts
Floor beam
4 layers tar building paper
28'
16' 0"
28'
2"
2"

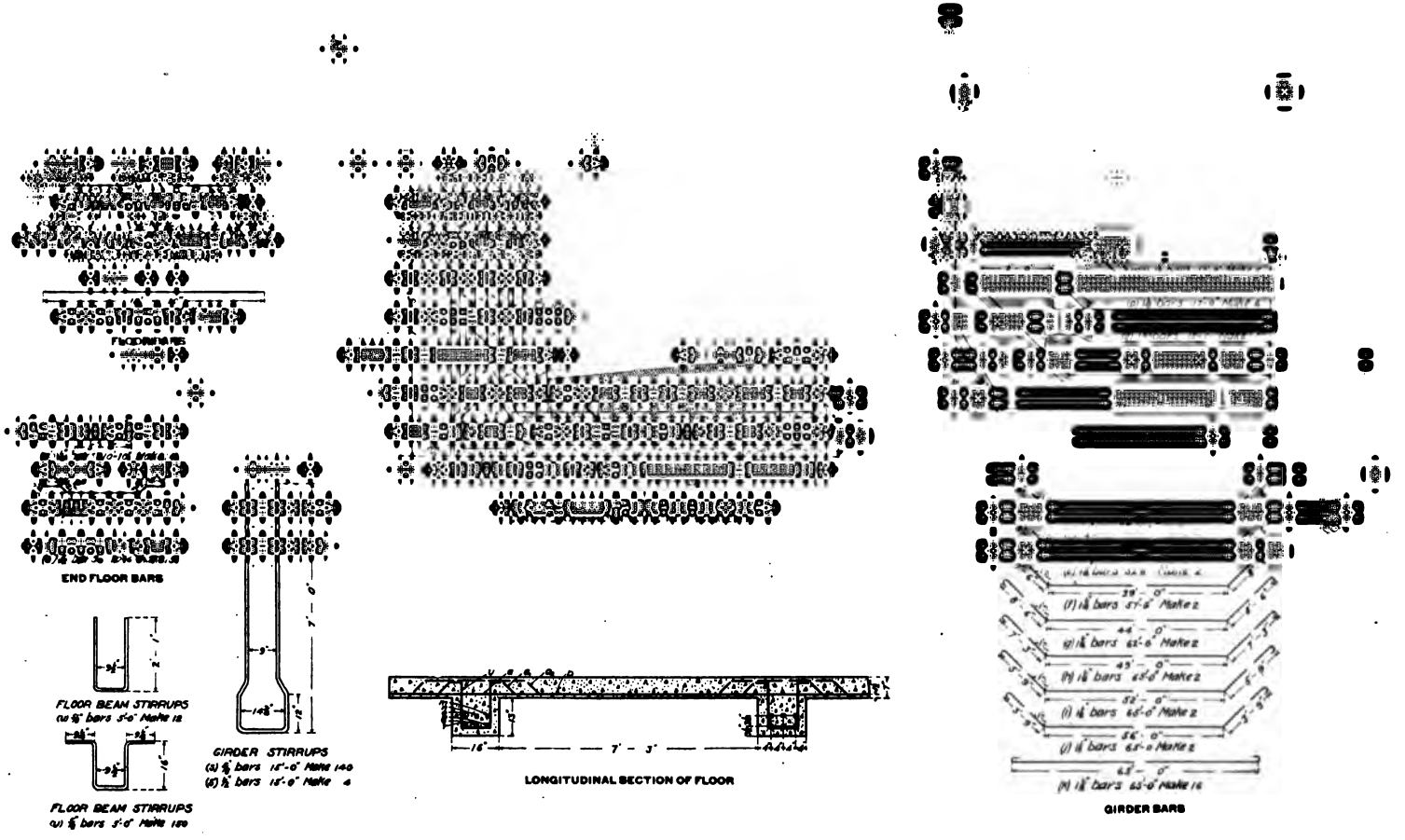


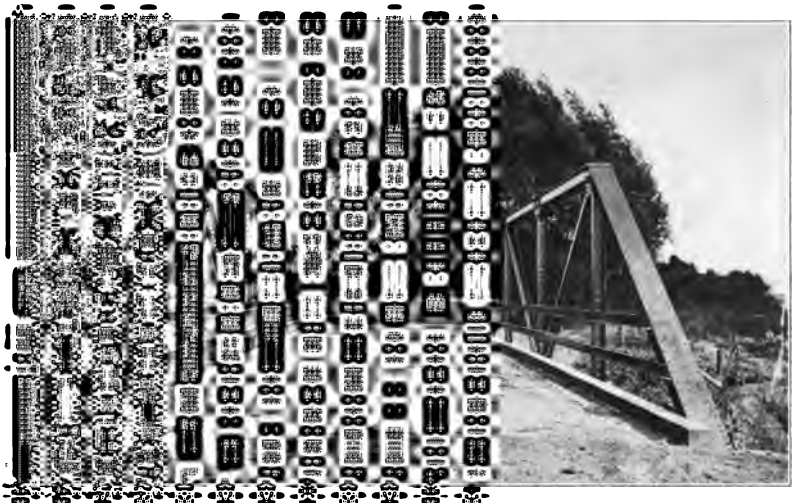
Figure No. 13. Details of reinforced 60 foot through girder bridge.

triangular moulding
ALL EXPOSED EDGES TO BE BEVELLED
BY USING 'A' MOULDING

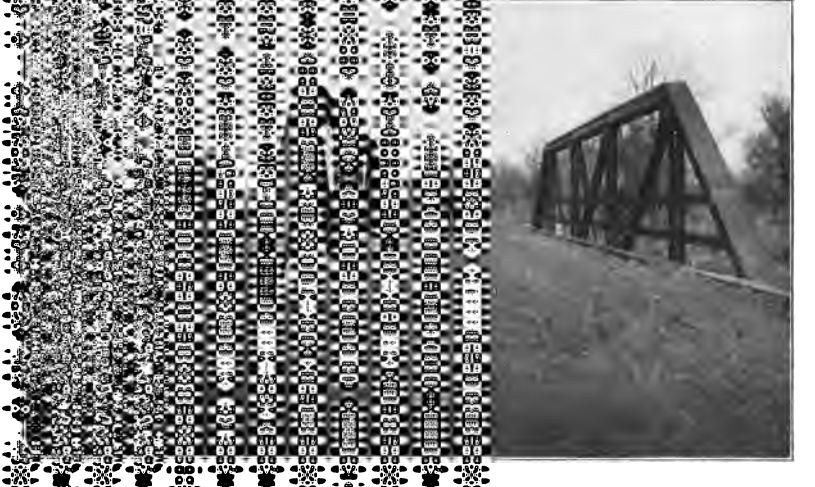
TABLE XIV.

Illinois Highway Commission—Summary of Bridge Work.

Year.	Inspections made.	Plans made.	Bridges Completed and Under Construction.	
			Steel.	Concrete.
1906	26	15	0	2
1907	156	113	7	32
1908	198	149	17	46
1909	135	122	38	71
Total	515	399	62	151



enry County. Span, 60 feet; superstructure, $1,040.00. Pan- st of substructure, $1,102.00. tractor. This view shows the the cushion or wearing surface Commission.



ove Township, Knox County. oor. Completed in 1909. Cost tractor. Cost of substructure, gravel cushion on the floor of wear and provides the san Designed by the Illinois Hi

OPINIONS OF THE ATTORNEY GENERAL.

In the reports of the Attorney General's office will be found various opinions bearing on road matters. All of those which seem of general importance are given herewith. A number of these opinions were rendered in answer to questions submitted by the State Highway Commission. The commission is in receipt of many inquiries concerning road work requiring legal knowledge for their answer. Many of these inquiries require no more for their answer than reference to certain statutes, but others of general importance, requiring legal interpretation, have been referred to the Attorney General, who has very courteously investigated all the points brought up and rendered opinions accordingly. As these opinions on road work affect a great many commissioners in all parts of the State, they should be read with great care, not only by commissioners but by all others interested in road work.

The opinions have been arranged under main headings and a synopsis of each opinion printed is also given. They have been arranged alphabetically, the significant words being placed first as far as possible.

There are a number of opinions concerning commissioners of highways as to their pay, powers, meetings, vacancies in office and liabilities. These are all headed under commissioner.

The opinion on dragging roads, a number of opinions affecting drainage, hard roads, laying out, narrowing roads and changing fences, on taxes, levies and expenditures and issuing of bonds on town line roads, bridges, and concerning traction engines, damage done to bridges by traction engines, are given under their respective headings.

Commissioners of Highways—Pay, Powers, Meetings, Vacancies, Liabilities.

1. Highway Commissioners elected for a full term, after July 1, 1905, are entitled to $2.00 per day.

2. The board of town auditors do not have the power to dictate to the highway commissioners when or how often they shall hold meetings, but if any meeting called by the highway commissioners is so glaringly unnecessary as to amount to a fraud, the board of town auditors would probably have power to take that fact into consideration in passing upon the claims of the highway commissioners for compensation.

Sept. 18, 1906.

Mr. Lawrence Murphy, Commissioner of Highways, Clinton, Illinois.

DEAR SIR—I have your letter of September 16, in which you ask for an opinion upon the proposition:

First—"Are highway commissioners entitled to two dollars per day?"

Second—"Has a town board of auditors any right of law in dictating to highway commissioners when they shall hold meetings."

In reply, will say that the compensation of highway commissioners who are elected prior to the first day of July, 1905, is $1.50 per day. The compensation of those who have been elected for a full term since the first day of July, 1905, is $2.00.

Paragraph 10, chapter 121, Hurd's Revised Statutes, 1905, provides with reference to the meetings of highway commissioners that,

"Said board shall hold regular meetings at such times as they shall designate, and special meetings as occasion may require, at the call of the president or any two of the commissioners; and no official business shall be transacted by the board, except at a regular or special meeting."

It would seem from this provision that the board of highway commissioners is authorized to hold such meetings as it may deem necessary to the transaction of business connected with the highways of the township. Whether or not the necessity exists for a meeting of the highway commissioners, is a matter that should be determined by the highway commissioners themselves. After the highway commissioners have determined that the necessity for a meeting exists, and in pursuance thereof, have held such meeting, it would not be within the power of the board of town auditors to review that question, and determine that such meeting was not necessary. I am therefore, of the opinion that the board of town auditors does not have the power to dictate to the highway commissioners when or how often they shall hold meetings for the purpose of transacting business connected with the highways.

However, paragraph 121, chapter 139, Hurd's Statutes, 1905, provides:

"The board of auditors shall, at the same time and place as stated in section 3, examine the accounts of the supervisor, overseer of the poor, (where the town sustains its own poor), and the commissioners of highways of such town, for all moneys received and disbursed by them, and shall also examine and audit all charges and claims against their town, and the compensation of all town officers, except the compensation of supervisors for county services."

It will be noted that by the provisions of said paragraph 121, the board of town auditors has the power to examine and audit the claims of the highway commissioners relative to their compensation. If any of the meetings called by the highway commissioners were so glaringly unnecessary as to amount to a fraud on their part against the public, the board of town auditors, under the above provision, would probably have the power to take that fact into consideration in determining the claims of the highway commissioners for compensation.

Very respectfully,
W. H. STEAD,
Attorney General.

When a highway commissioner removes from the highway commissioner's district, in which he was elected, to another highway commissioner's district in the same town, he thereby vacates his office of highway commissioner.

March 16, 1907.

Mr. J. W. Crites, Colfax, Illinois.

DEAR SIR—I have your favor of the 13th inst., in which you say your town is divided into three road commissioner's districts, and that you being the commissioner in district No. 1 have moved into district No. 2, and you inquire, "Do I by so moving into district No. 2 forfeit my office?"

Flattenhoff bridge, Colona Township, Henry County. View before reconstruction showing old timber structure. Timber, once the cheapest bridge material, is now the most expensive.

Replying thereto, permit me to say that it is the holding of this office that when a highway commissioner removes from the district in which he was serving as commissioner, he thereby vacates his office, it being the policy of the law that the road commissioner shall live in the district in which he was elected.

Very respectfully,
W. H. STEAD,
Attorney General.

When attending the semi-annual meeting prescribed by law, the commissioners of highways are entitled to a per diem compensation.

March 2, 1908.

Mr. B. F. Lovin, Belle Rive, Illinois.

DEAR SIR—Yours of the 29th ult., at hand. You ask whether a highway commissioner is entitled to pay for attendance at the semi-annual meetings of the town auditors and highway commissioners.

Section 66 of the roads and bridges act provides:

"The commissioners shall each receive for their services the sum of two dollars per day for each day necessarily employed in the performance of their duties, upon a sworn statement to be filed by each commissioner in the town clerk's office showing the number of days he was employed and the kind of employment and giving the dates thereof."

Section 13 of the roads and bridges act provides that the commissioners shall meet semi-annually on the same day and at the same place of meeting of the board of town auditors.

Under these sections, I am of the opinion that when attending this semi-annual meeting, the commissioners are employed in the necessary work for the town and are entitled to the per diem as prescribed by the statutes.

Very respectfully,
W. H. STEAD,
Attorney General.

In townships operating under the "cash system," there is no law which in any way limits the amount to be paid by the commissioners to those employed to perform labor on the highways to $1.00 per day, or to any other sum.

Jan. 22, 1907.

Hon. Fred Keck, Member House of Representatives, Springfield, Illinois.

DEAR SIR—You have submitted to me the question as to whether there is any statutory provision limiting the wages of those who labor on the highway under employment by the highway commissioners to one dollar per day. You state your county is under township organization, and your township has never adopted the "labor system" of work on the highways, but is operating under the "cash system." You state further that it has been claimed by some that under the law as it now stands, as applied to your township, the commissioners cannot pay those whom they employ to perform labor on the highway, to exceed one dollar per day.

The law governing this subject is found in chapter 121, Hurd's Revised Statutes, 1905, section one (1) to one hundred twenty-four (124), inclusive of said chapter, relate to counties under township organization. Section one (1) to seventy-nine (79), inclusive, apply to townships which are operating under the "cash system" and which have never adopted the "labor system" of road work. Sections eighty (80) to one to one hundred twenty-four (124), inclusive, apply to townships which have abandoned the "cash system" by adopting the "labor system" under the provisions of section eighty (80).

There is nothing, whatever, in the sections referred to as applying to townships operating under the "cash system" which in any way limits the amount to be paid by commissioners to those employed to perform labor on the highways, to one dollar per day or any other sum. Section 2 of said chapter 121 provides the commissioners shall have charge of the roads and bridges of their respective towns, and makes it their duty to keep the

roads and bridges in their respective towns in repair and to improve them so far as practicable, and requires them, whenever they have the means available, to construct permanent roads, and said section contains some general provisions as to when and how the work shall be done.

Section 3 provides that, in order to insure efficiency they may employ a general superintendent outside of their own body to carry out their orders, or they may divide the work, let contracts, appoint overseers, employ laborers or such other agencies as they may deem expedient and most to the interests of the town.

The fact that these two sections and others which might be referred to, are in very general terms vesting the commissioners with broad general powers and discretion, together with the fact that there are no other provisions applicable to towns operating under the "cash system" which in any way limit the discretion or power of the commissioners in the matter of per diem for road work, leads to the conclusion that the commissioners may in their judgment and discretion pay whatever such labor is worth; and what such labor is worth will depend upon the labor market which will vary or fluctuate from time to time, according to the demand for labor in other employments and depending upon many other influences. These are the considerations, in my judgment, which caused the Legislature to leave the question of wages to be paid for road labor to the judgment and discretion of the commissioners.

Section 96 provides that every person to whom road work has been assessed except the overseer himself may elect to commute for his road labor, or any part thereof, at the rate of one dollar per day, the communication money being paid to the overseer, etc. This is the only section of the entire chapter which mentions one dollar a day for labor on the highway, and this is by way of commutation, and applies to road work in townships in which the "labor system" has been adopted and has no application, whatever, to townships in which the "cash system" has not been abandoned.

I am of the opinion, therefore, that in your township, and in all townships operating under the "cash system" in counties under township organization, the highway commissioners are not limited to the sum of one dollar per day for road labor, but may pay whatever sum is necessary and proper under labor market and other conditions, to secure necessary labor on the highways.

Very respectfully,
W. H. STEAD,
Attorney General.

Authority over roads running through an unincorporated settlement is in the commissioners of highways.

April 25, 1908.

Mr. E. C. Stonecipher, Carter, Illinois.

DEAR SIR—I have your favor of the 24th inst., in which you ask a question in the following language:

"I want to know, in towns under township organization, who has the authority over the streets, where the town is not incorporated. Who has the proper authority where the railroad crosses the street, to have the railroad put in a crossing? Have the highway commissioners the authority? If not, tell me who has."

Replying thereto, I would state that the authority over the roads running through an unincorporated settlement such as indicated above would be in the commissioners of highways or the township.

Very respectfully,
W. H. STEAD,
Attorney General.

1. The highway commissioners have no power to create a debt in any fiscal year beyond the amount of taxes levied for that year.

2. Contracts costing $75.00 or more must be made at a public letting.

Klattenhoff bridge, Colona Township, Henry County. Span, 150 feet; roadway, 16 feet; concrete floor. Completed in 1909. Cost of superstructure, $3,823.00. LaFayette Engineering Company, contractor. Cost of substructure, $1,990.00. Tremont Bridge and Concrete Company, contractor. The abutments are built of reinforced concrete; the floor is also reinforced concrete.
Designed by the Illinois Highway Commission.

Dec. 12, 1906.

Mr. Fred Golder, Highway Commissioner, Carlyle, Illinois.

DEAR SIR—I have your favor of recent date in which you inquire: "Can a board of highway commissioners let a contract to a bridge company for a bridge for a length of time; say sixteen months, if they have not the funds on hands to purchase sooner?

Also can they purchase a bridge costing about one hundred dollars at a private letting or must it be at a public letting?"

In reply to your first question, I would say that section 28, of chapter 121, Hurd's Revised Statutes, 1905, provides:

"All contracts for the construction or repair of roads, or building or repairing bridges shall be made payable as soon as the work on said contract is completed and accepted by the commissioners."

If the highway commissioners have not the funds with which to construct or repair the bridge, section 14 of chapter 121 provides the means by which an additional levy may be made to meet such necessary expense. After a levy has been made, section 2 of chapter 146a grants to highway commissioners power to draw warrants in anticipation of such levy to meet and defray the ordinary expenses of the repair or construction of roads and bridges for which the tax has been levied. The highway commissioners have no power to create a debt against the road district. In the case of Commissioners of Highways v. Newell, 80 Ill., 587, it is held:

"The commissioners of highways have no legal power to incur indebtedness for road and bridge purposes in any fiscal year beyond the amount of the taxes already levied for that year. In other words they can in no one year expend lawfully more than the tax levied for that year."

It is also held in Sullivan v. Commissioners, 114 Ill., 262:

"The commissioners of highways have no authority at law to contract an indebtedness in respect to roads and bridges when the money to pay the same is not in their treasury to be expended, or has not already been actually levied."

Respecting the second question, I answer that section 25, of chapter 121 provides:

"The commissioners are hereby authorized to contract for the construction and repairing of roads and bridges, but when such contracts are for a sum exceeding $75.00, they shall give at least ten days notice of time and place of letting such contract, by posting notices in at least ten public places in and contiguous to the town, describing the work and time of completion: Provided, in case where bridges have been suddenly destroyed on any important highway, then such commissioners may privately contract for replacing such bridges to an amount not exceeding $150.00."

Section 26 also provides for the construction and repairing of roads and bridges on town lines, or across streams on town lines, which you may read for your guidance, should such question arise.

From the section last quoted you will see that it is the duty of the commissioners to let contracts costing $75.00 or more at public letting.

Very respectfully,

W. H. STEAD,

Attorney General.

The statute contemplates that the commissioners of highways shall hold their regular meetings at the office of the town clerk.

June 19, 1907.

Messrs. Humphrey & Anderson, Attorneys at Law, Lincoln, Illinois.

GENTLEMEN—I have your favor of the 15th inst., in which you submit the following statement of facts:

The township of Orvil in your county consists of a congressional township with an additional row of sections on the north, from 31 to 36.

The village of Hartsburg is situated in section 21. The village of Emden is situated on the west half of section 6. The town hall is situated in the

village of Hartsburg. The office of the town clerk is in the village of Emden. The commissioners of highways met and organized in accordance with the law in the office of the town clerk in the village of Emden. At the meeting at the office of the town clerk after the organization of the commission, the commissions of highways decided by resolution to meet thereafter, except the tax meeting, at the town hall in Hartsburg. Since that time said commissioners have been meeting at the town hall. The town clerk declines to meet at the town hall at Hartsburg, but claims that the commissioners should meet at all times with him at his place in Emden.

The question submitted by you is as to whether or not the commissioners are bound in law to meet at the office of the town clerk, or whether a majority have the legal right to meet anywhere in the township.

Section 10, chapter 121, Hurd's Revised Statutes, 1905, provides in part that:

"That commissioners of each town shall meet on the second Tuesday after the annual town meeting in each year, at the town clerk's office, and shall organize as a board by electing one of their number president and one of their number treasurer, and the town clerk shall be *ex officio* clerk of said board * * * Said board shall hold their regular meetings at such times as they shall designate, and special meetings, as occasions may require * * *."

Section 13 of the same chapter provides that in making the tax levy the commissioners shall meet at the same time and place as the board of town auditors.

By paragraph 120, chapter 139, Hurd's Revised Statutes, 1905, the board of town auditors are required to meet at the town clerk's office.

So far as I have been able to find, the courts have not passed upon the question as to whether or not a regular meeting of commissioners of highways may be held at a place other than the town clerk's office. However, from a careful consideration of the statutes above quoted and referred to, I am inclined to the view that the statute contemplates that the commissioners of highways should hold their regular meetings at the office of the town clerk.

Section 10 above quoted, it will be noted, provides that the annual meetings shall be held at the office of the town clerk. At such annual meeting the commissioners may designate the times of holding regular meetings. The statute does not give the commissioners power to designate the place of holding the regular meetings. By specially stating that the times of holding the regular meetings may be fixed by the commissioners of highways the idea that the places of such meetings may also be fixed, seems to be excluded. It will be noted that the language of the statute is that said board shall hold regular meetings at such times as they shall designate, but nothing is said about the place or places of meeting.

This view is in accordance with that of Attorney General Akin, who on April 25, 1898, in a letter to Mr. C. M. Drury, Delavan, Illinois, after referring to the statutes referred to in this letter, said:

"From these provisions of the law it would seem to be reasonably plain that the town clerk's office is the legal place for the meeting of the commissioners of highways." (Attorney General's Report, 1897-1898, p. 328.)

While the proposition is not entirely free from doubt, yet I am inclined to the opinion above expressed.

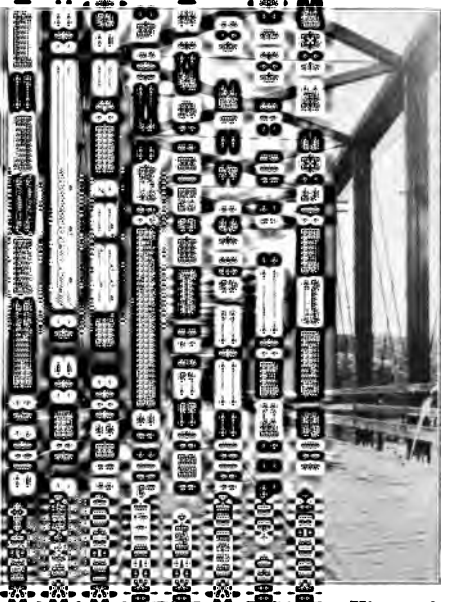
Very respectfully,
W. H. STEAD,
Attorney General.

If a vacancy occurs in the office of the highway commissioner, it is filled by appointment and not by election.

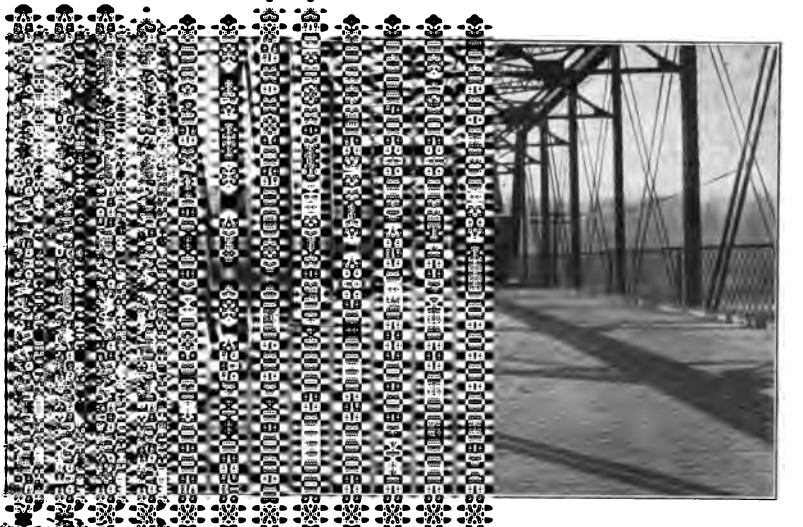
Oct. 18, 1907.

Mr. Joseph Robinson, Supervisor, Grayville, Illinois.

DEAR SIR—I beg to acknowledge receipt of yours of the 15th instant. You state that the road commissioner of Gray township died during the first



View of roadway before reconstructed roadway.



as reconstructed. Note th
ement and concrete sidewal

part of his term and ask whether or not his successor shall be appointed to fill the unexpired term or whether you should appoint him until the next election.

In reply will say that section 97, chapter 139, Hurd's Revised Statutes, 1905, provides as follows:

"Whenever any town shall fail to elect the proper number of town officers to which such town may be entitled by law, or when the person elected to any town office shall fail to qualify, or whenever any vacancy shall happen in any town, from death, resignation, removal from the town, or other cause, it shall be lawful for the justices of the peace of the town, together with the supervisor and town clerk, to fill the vacancy by appointment, by warrant, under their hands and seals; and the persons so appointed shall hold their respective offices during the unexpired term of the persons in whose stead they have been appointed, and until others are elected and appointed in their places, and shall have the same powers and be subject to the same duties and penalties as if they had been duly elected and appointed by the electors."

Under this section I am of the opinion that the board of appointment, as above provided, can legally fill the vacancy caused by the death of your highway commissioner by appointment, for the unexpired term, notwithstanding the unexpired term exceeds one year. People v. Van Horne, 18 Wend., R. 515; Haines Township Law, page 89; Dennison v. Spencer, 101 Ill. App., 89; Opinions of Attorney General of Illinois, 1901-1902, p. 304.

A constitutional provision that a person appointed to fill a vacancy, shall hold "until the next regular election" means until the next election for that office. Throop Public Officers, Sec. 308; People v. Wilson, 72 N. C., 155.

You also ask if it is necessary for you to make any appointment to fill the vacancy. In reply will say:

"The law abhors vacancies in public offices, and great precautions are taken to guard against its occurrence. The policy of the law is to have some one always in place to discharge the duties of public offices."

State v. Seay, 64 Mo., 89; Throop on Public Officers, Sec. 308. The highway commissioners of the town are a *quasi* corporation, and all such bodies act by majority. Therefore, it seems to me that in order to properly carry out the duties imposed by statute, and to subserve the best interests of the public, the vacancy on your board should be filled at once, by appointment, as above provided.

Very respectfully,
W. H. STEAD,
Attorney General.

Judgment against the highway commissioners in their official capacity should be paid out of the road and bridge fund.

Sept. 11, 1907.

Mr. F. E. Thayer, Town Clerk, Oregon, Illinois.

DEAR SIR—I have your favor of recent date in which you state that a judgment was recovered against the commissioners of highways of the town of Oregon for materials furnished and work done on the public highways of the town. The judgment creditor insists that this judgment should be paid out of the general township fund, and presented the judgment as a claim against the township to the town auditors of said town, together with a written demand for the payment of the same. The board of town auditors has taken the position that the judgment should be paid out of the fund raised for road and bridge purposes. You request an opinion from this office as to which fund should be charged with the payment of this judgment. I assume that the labor and materials furnished which constitute the foundation of this judgment are labor and materials of the kind for the payment of which the road and bridge law authorizes the levy of a road and bridge tax.

By the road and bridges act the charge and care of the highways of the town devolve upon the highway commissioners. The highway commission-

ers are required to organize as a board by electing one of their number president, and one of their number treasurer, and the town clerk acts *ex officio* as clerk for the board of highway commissioners. The board of highway commissioners thus becomes a *quasi* corporation. People v. Madison County, 125 Ill., at p. 342; People v. Finley, 97 App., at p. 216.

The said act provides for levying a tax for road and bridge purposes. When the tax is collected, it is turned over to the treasurer of the board of highway commissioners, and is paid out only upon the order of the highway commissioners acting as a board. Suits by or against the highway commissioners arising out of their relation to the highways of the town must be instituted and proceed against the highway commissioners in their official capacity and not as individuals. Town of Rutland v. Town of Dayton, 60 Ill., p. 60; Lang v. Soffell, 33 Ill. App., 624.

It thus appears that the statute has created a special fund for the support and maintenance of the roads and bridges of the township. It is clear, then, that if there had been no controversy between the judgment creditor in the case under consideration, and the board of highway commissioners as to the validity of the claim which was the foundation of the judgment, and the board of highway commissioners had allowed the claim without the necessity of resorting to suit, the same would have been paid out of the road and bridge fund. I perceive no reason why the mere fact that the controversy did arise as to the validity of the claim, and resort to a law suit was necessary to establish it, and that it was established by a judgment against the board of highway commissioners, should make any difference as to what fund it should be paid out of.

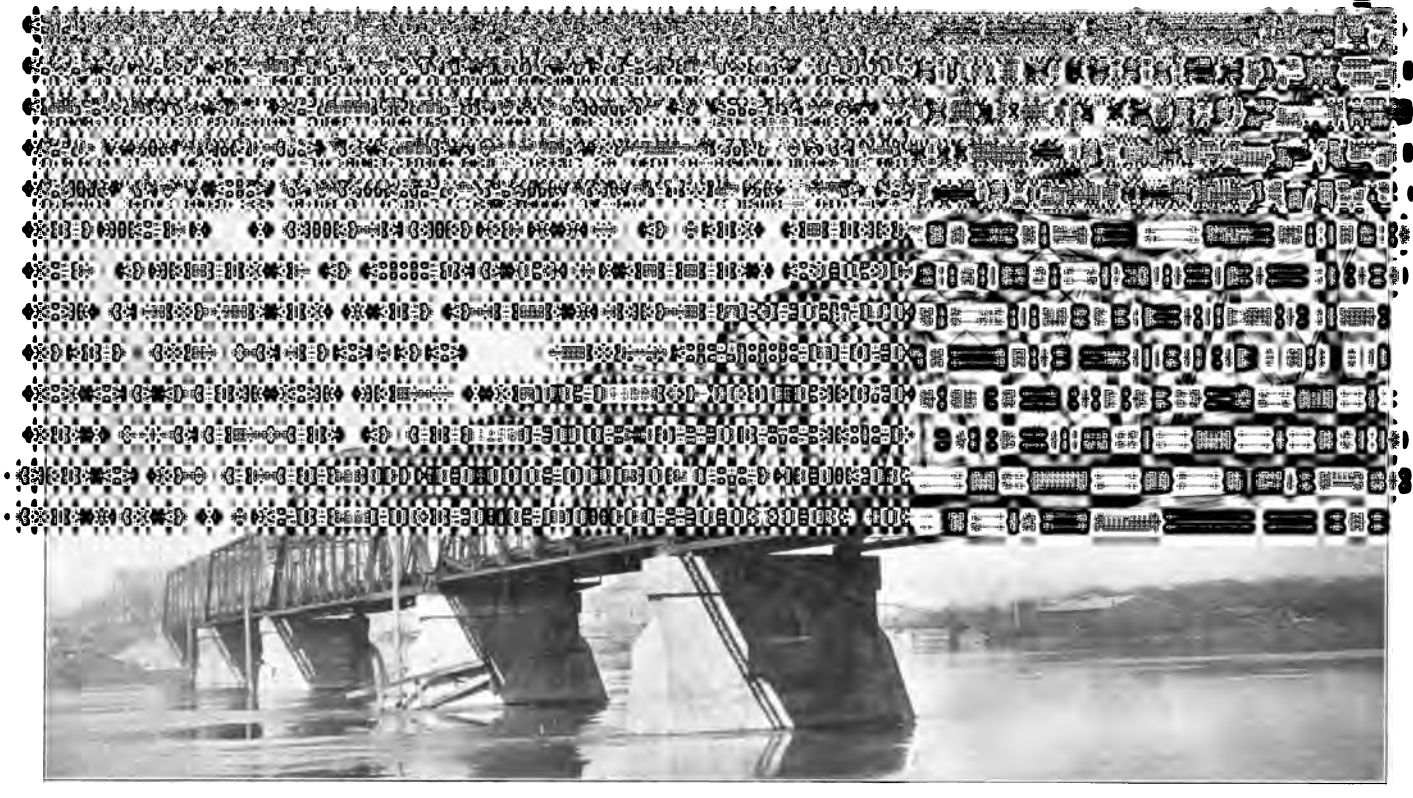
It is suggested, however, that by the provisions of paragraph 50, chapter 139, Hurd's Revised Statutes, 1905, that such a claim as this is, when reduced to judgment, should be paid out of the general township fund, and not out of the road and bridge fund. That paragraph is as follows:

"In all suits or proceedings prosecuted by or against town officers, in their name of office, costs shall be recovered as in like cases between individuals. Judgment recovered against a town or against town officers, in actions prosecuted by or against them, in their name of office, shall be a town charge, and when collected, shall be paid to the person or persons to whom the same shall have been adjudged."

I think that this construction of this paragraph results from a misapprehension of its purpose. Under the township organization act suit by or against a town should be instituted and proceed in the name of the town. There are instances, however, in which suits are authorized, and in some instances required, to be brought against the township officers in their official capacity. Town of Rutland v. Town of Dayton, 60 Ill., at p. 60.

It was the purpose of this paragraph to provide that when suits were brought against township officers in their official capacity, the township officers should not be personally liable for the judgment or the costs of said suits. It was not the purpose of this paragraph to indicate what fund such judgment should be paid out of, but merely to provide that the judgment should be paid by the body which the officers officially represented rather than by the officers as individuals. Support of this construction is afforded by references to kindred legislation passed at the same session of the Legislature that enacted said paragraph 50. Said paragraph 50 was passed by the Legislature of 1861. At the same session of the Legislature the following section concerning township organization was enacted, to-wit, section 21, page 250, Session Laws of 1861. That section is as follows:

"Any judgment recorded against the commissioners of highways, in their official capacity, under the provisions hereof, shall be a charge of said town, and collected in the same manner as other town charges, except in cases when the court, before which the judgment shall be recorded shall certify that the neglect or refusal of said commissioners was wilful or malicious; in which case said commissioners shall be personally liable for such judgment, and the same may be enforced against them in the same manner as against individuals."



Illinois River Bridge at Ottawa, La Salle County, designed by the Illinois Highway Commission. The bridge consists of six spans. Total length, 930 feet. But five of the spans are seen in this view. Contractors of substructure, A. M. Blodgett Construction Company, Kansas City, Mo. Contractors of superstructure, Modern Steel Structural Company, Waukesha, Wis.

It was evidently the clear intention of the Legislature by enacting said section 21 to provide that highway commissioners should not be personally liable for judgments rendered against them in their official capacity, unless the judgment was the result of their wilful or malicious neglect. This would indicate that it was the intention of the Legislature in enacting said paragraph 50 to provide that other township officers should not be personally liable for judgments rendered against them in their official capacity.

Even if it be true that a judgment against the highway commissioners in their official capacity for materials furnished and work done on the public highways may be regarded as a town charge, it is likewise true that the roads and bridges act has provided a special fund out of which the costs of such labor and material should be paid. This fund may be regarded in a certain sense as a township fund for the special purpose of supporting and maintaining the highways of the town. It does not follow, then, that merely because a judgment for materials furnished and work done on the public highways of the town may, in a certain sense, be regarded as a town charge, such a judgment should be paid out of the general township fund, especially when the statute has created a special fund for the support and maintenance of the roads and bridges of the town.

I am therefore, of the opinion that this judgment should be paid out of the road and bridge fund.

Very respectfully,
W. H. STEAD,
Attorney General.

DRAGGING ROADS.

March 23, 1908.

Hon. A. N. Johnson, State Engineer, Springfield, Illinois.

DEAR SIR—Your favor of the 20th inst., relative to the construction of the road drag law is received, and in reply thereto I would state that your construction of the said law, namely,

"That unless the commissioners had made a special contract, written or verbal, with the land owners or tenants instructing them to drag the road, that they could not recover for any work that they should do without such instructions, nor compel the commissioners to make a contract with them," is concurred in by this department.

Very respectfully,
W. H. STEAD,
Attorney General.

DRAINAGE.

Inasmuch as commissioners of highways are charged with the duty of draining roads, they must discharge such duty, and the law does not cast upon a land owner any part of the duty of aiding in the opening of a ditch.

August 27, 1908.

Mr. Fred Barnes, Esmond, Illinois.

DEAR SIR—I have your favor of the 25th inst., in which you say:

"Complaint has been made to the highway commissioners to drain a portion of road where waters stand for several months in the year, who refuse to do the same because a ditch must be cleaned out which has been a natural water course for more than ten years as a ditch; but it is filled up and must be opened for 160 rods."

You further say the farmer over whose lands the ditch runs refused to help and for that reason the commissioners refused to open it, on the ground that the town would refuse to allow the bill.

In reply, I would say that section 2 of chapter 121, Hurd's Revised Statutes, 1905, gives highway commissioners charge of the roads and bridges

in their respective towns and makes it their duty to keep the same in repair and to improve them so far as is practicable. Section 8 of the same act authorizes the commissioners of highways to enter upon any land adjacent to any highway in their town,

"For the purpose of opening any ditch, drain necessary sluice or water course, whenever it shall be necessary to open a water course from any highway to the natural course and to dig, open and clean ditches upon said land for the purpose of carrying off the water from said highway, or to drain any slough or pond on said highway."

These sections of the statute make it the duty of highway commissioners to drain the water off the roads under their control and gives them ample power to perform that duty.

Section 67 of the same act provides:

"If the commissioners shall wilfully refuse or neglect to perform any of the duties imposed on them by this act, they shall severally forfeit not less than ten dollars nor more than fifty dollars and may be proceeded against in the name of the town."

The road law as above stated makes it the duty of the commissioners to carry out the various provisions of the same as therein provided and affixes a penalty against such commissioners who fail or neglect to perform their duty. The reason given in your letter for failure to perform the duty would not in my judgment avail the commissioners in a court. The fact that the commissioners are charged with the duty of draining the road and are given authority to do it makes it obligatory upon them to discharge that duty and the law does not cast upon the land owners any part of the duty or responsibility of aiding in the opening of said ditch.

This opinion is not official and should not be so considered but is given out of courtesy to you.

Very respectfully,
W. H. STEAD,
Attorney General.

Adjacent land owners, or occupants, cannot compel the road authorities to permit such land owners, or occupants, to connect their tile drains with the tile drain on the public highway.

Aug. 27, 1908.

Mr. William L. Still, Commissioner of Highways, Alpha, Illinois.

DEAR SIR—I have your favor of recent date in which you say that a land owner wants to connect fifty rods of four inch tiling to the tiling on the highway and you inquire whether he can force you to allow him to connect his tile with the drain of the highway.

Replying permit me to say that section 6, chapter 121, Hurd's Revised Statutes, 1905, provides:

"Whenever the commissioners are about to lay a tile drain along the public road they shall have power to contract with the owners or occupants of the adjoining lands to lay larger tile than would be necessary to drain the roads and to permit connection therewith by such contracting parties to drain their lands."

This is the only section of the road law to which my attention has been called, authorizing the connection of tiles from the land of adjacent owners or occupants with the title drain of the road and this section only applies to cases where the road authorities are preparing to lay tile drains for the road. It does not apply to a case where the road authorities have already drained the road by the use of tiling; and the adjacent land owners or occupants in my judgment cannot compel the road authorities to permit such connection of tile drains from the adjacent lands with the tile drain of the public highway.

This opinion is in no sense official and is given out of courtesy to you.

Very respectfully,
W. H. STEAD,
Attorney General.

Where the drainage commissioners cut a drainage ditch across a highway, it is the duty of the highway commissioners to build a bridge across such ditch.

June 5, 1907.

Mr. James R. Swan, Town Clerk, Chambersburg, Illinois.

DEAR SIR—I have your favor of the 1st inst., in which you inquire who is to build the bridge across a ditch which is being cut across a public highway by the drainage commissioners, whether the drainage commissioners or the highway commissioners.

Replying thereto permit me to say that section 115 of chapter 42, Hurd's Revised Statutes, 1905, provides:

"The commissioners shall have the power and are required to make all necessary bridges and culverts along or across any public highway or railroad which may be deemed necessary for the use or protection of the work, and the cost of the same shall be paid out of the road and bridge tax, or by the railroad company, as the case may be: Provided, however, notice shall first be given to the road or railroad authorities to build or construct such bridge or culvert, and they shall have thirty days in which to build or construct the same, such bridge or culverts shall in all cases be constructed so as not to interfere with the free flow of water through the drains of the district. * * * The proper authorities of any public road or railroad shall have the right of appeal the same as provided for individual owners."

This section you will see makes it the duty of the commissioners of highways to build the bridge or culvert across the ditch across any public highway, and they have thirty days after legal notice given by the drainage commissioners in which to build the bridge or culvert, and in case they refuse to construct the same, the drainage commissioners are authorized to construct the same and recover the cost of such bridge or culvert from the town. This section was construed in part by the Supreme Court in the case of Drainage Commissioners v. Highway Commissioners, 220 Ill., 172. The same had been before the Supreme Court in 199 Ill., 80.

It is my opinion, therefore, that the highway commissioners should build the bridge across the ditch as provided in the section of statute above quoted.

Very respectfully,

W. H. STEAD,

Attorney General.

HARD ROADS.

A road constructed under the gravel and hard roads act, need not be the same width within, as without, the city, but the unit area of surface should cost the same outside, as inside, the city, and the same methods of construction and kind of material should be used both inside and outside the city.

Feb. 28, 1908.

Hon. A. N. Johnson, State Highway Engineer, Springfield, Illinois.

DEAR SIR—I have your favor of the 18th inst., receipt of which has heretofore been acknowledged, in which you re-enclose to this office a letter which was forwarded to you by this department from the city attorney of Greenville, Illinois, and you ask, for your guidance, my opinion as to the question submitted in the letter of the city attorney.

It appears from the city attorney's letter, that at the town election of the town of Central, Bond County, Illinois, the proposition submitted to the voters of the town of Central for a hard road in said town, carried at the town election, and a levy was made for the purpose of building hard roads in said town, pursuant to the vote of the town thereon.

The commissioners of highways of the town of Central have contracted with the municipal authorities of the city of Greenville to extend such hard

roads through the city limits of the city of Greenville. The commissioners of highways design to build the road sixteen feet in width in the city limits and twelve feet in width outside of the city limits.

The question is whether or not the statute will authorize the commissioners so to construct the road.

The proposed road will be built under the provisions of an act entitled, "An Act to authorize the construction and maintenance of gravel, rock, macadam or other hard roads," approved June 18, 1883, in force July 1, 1883, and acts amendatory thereof.

Section 1 of the Act provides for a petition to have the question submitted to the voters of the town, and section 2 provides the form of ballot. Section 3 provides that, in case proposition carries, the commissioners of highways shall levy a tax. Section 4 makes it the duty of the county clerk to extend the tax as levied and section 5 makes it the duty of the treasurer of commissioners of highways before receiving any of the funds, to execute a bond. Section 6 makes it the duty of the tax collector to pay the taxes, when collected, to the treasurer of the commissioners of highways.

Section 7 provides as follows:

"The commissioners of highways shall have power to employ a competent surveyor or civil engineer and their necessary assistants, for the purpose of surveying the route of the road to be improved, and make plans and specifications and estimates of said work. The commissioners shall cause the same to be divided into convenient sections and each section numbered."

Section 8 provides for the advertisements for bids and for the publication of notices.

Section 9 provides as follows:

"The plans and specifications shall provide for the grading of a road bed of not less than twenty feet in width on the surface and so constructed as to drain freely to the sides, and with all necessary side and lateral ditches and tile drains, bridges and culverts, and a track laid with gravel, rock, macadam or other hard and durable substance, not less than seven, nor more than sixteen feet in width, and if constructed of gravel or broken stone, not less than ten inches thick in the center, and eight inches thick on the edges: Provided, however, this section shall be considered as directory only, and not shall prohibit the making of roads of different width or thickness, in the discretion of the commissioners."

The remainder of the Act, up to section 16½ provides for letting the contract and doing the work. So far, the Act contemplates the construction of the hard road outside the limits of a city or village. I take it that in such case, there could be no question under the provisions of section 9 that part of the road might be sixteen feet in width and part of the road twelve feet in width.

In 1905, section 16½ was added to the act. Said section 16½ provides as follows:

"Whenever a special tax shall have been levied under the provisions of this act in any town, the commissioners of highways of such town may, by agreement with the city council or board of trustees of any city or village of less than ten thousand population within the limits of such town, extend any road improved under the provisions of this act within or through the corporate limits of such city or village, provided, such extension within such city or village shall be of the same cost and kind of material as the road outside such city or village, to be paid for out of said special tax and after completion to be maintained by the municipal authorities of such city or village, at the cost of such city or village."

The object of this section was to allow the extension of a hard road through a city or village. To guard against a more expensive road being constructed in the city or village, the proviso above underscored was added.

I agree with your construction that the "same cost and kind of material" would mean a road whose unit area of surface would cost the same outside

as inside the city or village limits, and that the same methods of construction and kind of material should be used both inside and outside the city or village limits.

I see no legal objection, therefore, why the road proposed to be built by the town of Central cannot be twelve feet wide outside the city limits and sixteen feet wide inside the city limits.

Very respectfully,
W. H. STEAD,
Attorney General.

Where a levy has been made under the hard roads act, and the money received from such levy was not sufficient to complete such road, the commissioners of highways are not authorized to levy a sum, as a contingency, to complete such road.

Aug. 25, 1908.

Mr. Wade S. Allison, Town Clerk, Gardner, Illinois.

DEAR SIR—I have your favor of the 22d inst., in which you state that the town of Garfield two years ago levied a hard road tax of one per cent for the term of two years to build a hard road between points in the town. The levy was not sufficient to complete the road. You ask:

"Could we legally levy the allowed contingency not to exceed 40 cents in addition to our 60 cents road and bridge tax?"

Replying thereto, I would state that in a town under a cash system—as I assume your town is—the levy of road and bridge taxes is made under the provisions of paragraph 13 and 14, chapter 121, Hurd's Revised Statutes, 1905. Under the provisions of paragraph 13 the commissioners of highways can levy a tax for road and bridge purposes and for the payment of any outstanding orders drawn by them on their treasurer at a rate not exceeding 60 cents on each $100. By the provisions of paragraph 14, if in the opinion of the commissioners a greater levy is needed, in view of some contingency, an additional levy may be made in any sum not exceeding 40 cents on the $100, with the consent of the board of town auditors and the assessor.

The Supreme Court has recently had occasion to define what is meant by the word "contingency" as used in said paragraph 14. The court says:

"A contingency has the element of uncertainty and doubt and is defined as an event which is possible but which may or may not occur. It is in the nature of a casualty, accident or chance, and results from an agency the operation of which is uncertain. It is dependent upon a possibility and on causes which are undetermined or unknown. * * * It is perhaps not strictly accurate to say that the statute requires an extraordinary or unusual contingency, since every contingency is uncertain and its happening cannot be predicted, but it is essential that there should be some contingency which requires the additional levy. People v. T., St. L. & W. R. R. Co., 231 Ill., 125.

In view of the holding of the Supreme Court as to what constitutes a contingency I am of the opinion that you cannot levy 40 cents on the $100 in addition to the 60 cents on the $100 to complete the hard road which you started to construct two years ago.

Very respectfully,
W. H. STEAD,
Attorney General.

LAYING OUT AND NARROWING ROADS AND FENCES.

1. Where the highway commissioners narrow a public highway, the soil of that part of it which is vacated becomes released of the easement of public travel and the title reverts to the owner of such soil.

2. Where the title has been placed in the soil, it becomes a part thereof, but if it is not removed before the road is narrowed, the highway commissioners could neither remove it nor require compensation for it thereafter.

Oct. 25, 1906.

Mr. S. J. Sloan, Commissioner of Highways, Milford, Illinois.

DEAR SIR—I have your favor of October 22d, in which you inquire:

"Whether we as road commissioners have a right when a petition is gotten up to narrow a road from 66 to 40 feet to give the land free of charge to the farmer along the road, or should we receive compensation for it? Also if the road is titled, have we a right to give them the title?"

In reply, I would say that by a proceeding of the highway commissioners under the statute to lay out a public road over land not within an incorporated town, city or village, the board of highway commissioners does not become the owner of the land over which the road passes. The public, thereby, acquires a right of way for road purposes over the land. The owner of the land over which the road passes at the time the road is laid out remains the owner in fee simple of the soil and retains the right to use the soil for any and all purposes not inconsistent with the use of it by the public for road purposes.

Speaking upon this subject our Supreme Court, in the case of the Town of Palatine v. Krueger, 121 Ill., 74, says:

"Where a highway is located over lands outside of an incorporated town, the public acquires only an easement of passage, with the rights incident thereto, while the owner of the land over which the road is laid retains the fee and the ownership of everything connected with the soil, for the purposes not incompatible with the public right of way. Town of Old Town v. Dooley, 81 Ill., 255; Dillon on Mun. Corp., sec. 544."

To the same effect is the case of the Postal Telegraph Company v. Eaton, 170 Ill., 513.

I am therefore, of the opinion that if a highway be narrowed in pursuance of the statute, the soil over which that part of it which may be vacated passes becomes released of the easement and the right of exclusive possession and enjoyment of the soil revests in the owner of such soil. This results without any affirmative action of the highway commissioners other than their official act in narrowing the road.

I am further of the opinion that after the tile has been placed in the soil, it becomes a part thereof, and if it be not removed before the road be narrowed, the highway commissioners could neither remove it nor require compensation for it thereafter.

Very respectfully,
W. H. STEAD,
Attorney General.

1. The costs of a proceeding to lay out roads cannot be taken out of the road and bridge fund, but, if payable at all, it would be payable out of the town fund.

2. The commissioners of highways are usually designated and known as township officers.

June 13, 1907.

Mr. John T. Ingram, County Attorney, Quincy, Illinois.

DEAR SIR—I have your favor of the 10th inst., in which you ask me to advise you by whom should be paid the costs in the matter of proceedings to lay out roads. You ask if these costs should be paid out of the road and bridge fund of the township, or should they be paid out of the town funds.

In the limited time which I have been able to give to the consideration of this matter, I have been unable to find any decision of our courts bearing directly upon this question. I can, therefore, only give you a few suggestions which occur to my mind.

Section 13 of chapter 121, Hurd's Revised Statutes, 1905, provides that:

"The commissioners shall also meet semi-annually; * * * At the meeting immediately preceding the meeting of the county board, the commissioners shall determine what per cent of the tax shall be levied on the property of the town for road and bridge purposes and for the payment of any outstanding orders drawn by them on their treasurer."

Section 14 of the same chapter provides for an additional tax in case of emergency.

Section 15 provides for the levying of a tax for the payment of damages for laying out, widening, altering or vacating the roads, or for ditching to drain roads.

Section 17 provides that:

"Whenever damages have been allowed for road and ditches, the commissioners may draw orders on their treasurer, payable only out of the tax to be levied for such roads or ditches, when the money shall be collected or received, to be given to persons damaged."

There is no other provision of statute authorizing the commissioners to levy a tax for any other purpose than that expressed in the sections before referred to.

In the case of Commissioners of Highways v. Howell, 80 Ill., 587, the Court say:

"The road and bridge tax levied for any given year is legally applicable for labor performed and expenditures made on the roads and bridges during that fiscal year, and cannot rightfully be applied to any other purpose, even the payment of prior indebtedness."

It would seem, therefore, that the payment of costs could not be taken out of the road and bridge fund. If payable at all, it occurs to me that such costs would be payable out of the town fund.

You also ask if the commissioners of highways are town officers within the meaning of that term as used in article 5, section 6 of the township organization act. Article 5, section 6 provides as follows:

"In all suits or proceedings prosecuted by or against town officers in their name of office, costs shall be recovered as in like cases between individuals. Judgments recovered against a town or against town officers in action, prosecuted by or against them, in their name of office, shall be a town charge, and when collected shall be paid to the person or persons to whom the same shall have been adjudged."

Inasmuch as the commissioners are elected for a township and serve for a township, such commissioners are usually designated township officers.

I call your attention to the case of Highway Commissioners of Rutland v. Highway Commissioners of Dayton, 60 Ill., 58.

This opinion, of course, must not be construed and considered as an official opinion of the Attorney General. The statutes provide the officers to whom official opinions shall be given.

Very respectfully,
W. H. STEAD,
Attorney General.

If the road had been laid out as required by law, and a record thereof made and recorded, then if fences encroach upon said road, the persons so maintaining such fences are guilty of maintaining a public nuisance, to be abated by the commissioners of highways, as provided by law.

May 16, 1907.

Mr. Christian Bigler, Mayor, Sigel, Illinois.

DEAR SIR—I have your favor of recent date in which you say:

"In 1864 said road was laid out, and a plain and undisputable record of the laying out is found in the township books in the township clerk's office."

You further say that a half mile of this road adjoining your town, having been traveled since it was laid out, becomes impassable during the wet

season, and the road cannot be put in proper condition because it cannot be worked properly for the reason that fences encroach on either side of the road. You further say that a petition has been presented to the commissioners to widen this part of the road; that it was customary as early as 1864 for the land owners to donate the land for the public highways, and you say that the present land-owners now demand damages for the land necessary to widen the road, and you inquire: "Are these present land-owners entitled to damage or are they not?"

Replying thereto, permit me to say that as the road mentioned in your letter was laid out of the width of four rods, as stated in the copy of the petition accompanying your letter, in 1864, and since that time the road has been used by the public as a highway, then the encroachments upon said road by the adjoining land owners would constitute a public nuisance.

It is provided by section 71 of chapter 121, Hurd's Revised Statutes, 1905, that:

"If any person shall injure or obstruct a public road * * * by placing or leaving any other obstruction thereon, or encroaching upon the same with any fence * * * they shall forfeit for every such offense a sum not less than three dollars, nor more than ten dollars; * * * and, provided, further, that the commissioners after having given reasonable notice (to the owners), or persons obstructing or plowing or digging ditches upon such road, of the obstruction, may remove any such fence or other obstruction * * * and recover the necessary cost of such removal from such owner or other person obstructing such road aforesaid, to be collected by said commissioners before any justice of the peace having jurisdiction."

No person has a right under our statute to encroach upon the public highway by fence or otherwise. This doctrine is stated in Elliott on Roads and Streets, sec. 659, as follows:

There can be no rightful permanent possession of a public highway for private purposes; * * * and no length of time will render a public nuisance, such as the obstruction of a highway, legal, or give the person guilty of maintaining it any right to continue it to the detriment of the public * * *."

This doctrine is recognized by our highest courts in numerous decisions.

If the road mentioned by you was laid out four rods in width, or sixty feet as the law now is, and recorded as you say, then the persons whose fences encroach upon said road are guilty of maintaining a public nuisance, which may be abated by the commissioners as provided in the section of the statute quoted.

The question as to whether the land owners received compensation for their land at the time the road was laid out by the public authorities cannot be raised by the present land owners. By the laying out, recording and opening of the road as a public highway, the public acquired the right to use the whole of the width of the road as laid out by the commissioners, and such right continues at this time.

It is, therefore, my opinion that the land owners, where the fences encroach upon the public highway, would not be entitled to damages for returning to the public land which belongs to the public highway. If, however, the land does not belong to the public as a highway, they would be entitled to damages, as provided in the road law for opening a new road or widening an old one.

Very respectfully,
W. H. STEAD,
Attorney General.

TAXES, LEVIES, EXPENDITURES AND BONDS.

1. While the law requires the consent of the "entire board," to levy a sum in addition to sixty cents on the one hundred dollars, for road and bridge purposes, the term "entire board" means a majority of the entire board and not a mere majority of a quorum of the board.

2. Where the board of town auditors and the assessor consent to an additional levy on account of a contingency, the money received from such additional levy must be used exclusively for the purpose of the contingency which brought it into existence.

3. While the law requires a town to be divided into three highway commissioners' districts, the taxes received from property in each district are not to be kept in the hands of the treasurer as a separate fund belonging to each district.

Oct. 29, 1906.

Mr. I. J. Earel, Supervisor, Quincy, Illinois.

DEAR SIR—I have your favor of October 24th in which you ask for a construction of paragraph 14, chapter 121, Hurd's Revised Statutes, 1905. That paragraph is as follows:

"If, in the opinion of the commissioners, a greater levy is needed in view of some contingency, they may certify the same to the board of town auditors and the assessor, a majority of whom shall be a quorum, and with the consent of a majority of this entire board given in writing, an additional levy may be made of any sum not exceeding forty cents on the one hundred dollars of the taxable property of the town."

You inquire whether the phrase "entire board" in the above paragraph contemplates that the board shall consist of the three highway commissioners, together with the board of town auditors and the assessor. I am inclined to the opinion that the board of consent created by said paragraph 14 consists only of the town auditors and the assessor. The clause providing that the consent of this board can be given only by a concurrence of a majority of the "entire board' contains the phrase "entire board;" for the purpose of designating that a majority of the entire board is required, and not a mere majority of a quorum of the board.

You further inquire whether the fund raised under the provisions of said paragraph 14 can be used for general road purposes, or whether it must be confined to the purposes of the contingency for which it was raised. It will be noted that paragraph 13 of said chapter provides for the levying of taxes for road and bridge purposes, and for the payment of any outstanding orders. It would seem, then, that the fund to be used for general road purposes is the fund that is created by the provision of said paragraph 13, and that the fund created by the provisions of said paragraph 14 is to be used for the contingency for which it was raised. Speaking upon this subject, our Supreme Court in People v. C., I. & W. Ry. Co., 213 Ill., p. 506, says:

"It will be seen that the second objection to this tax which was sustained by the courts is, that the board of auditors, had no authority to consent to the levy, or the commissioners to levy, an additional forty cents to pay orders heretofore issued, or for road and bridge purposes. Section 13 of the road and bridge act gives the commissioners the power to levy a tax for road and bridge purposes and for the payment of any outstanding orders drawn by them on their treasurer, which levy shall not exceed sixty cents on each $100.00. The following section provides that "if in the opinion of the commissioners, a greater levy is needed in view of some contingency, they may certify the same to the board of town auditors and the assessor, a majority of whom shall be a quorum, and with the consent of a majority of this entire board given in writing, an additional levy may be made of any sum not exceeding forty cents on the $100.00 of the taxable property of the town. This forty cents on the $100.00 must be to meet some contingency, and not to pay the ordinary expenses provided for in section 13, incurred in the usual manner."

I am of the opinion that the fund raised in accordance with the provisions of said paragraph 14 should be used exclusively for the purposes of the contingency which brought it into existence.

pense. If it did not, then it is a matter of choice as to whether the town shall aid in rebuilding a bridge or not, provided, of course, that the question of allotting the road does not effect the question of the liability of said town.

Referring to the question as to what effect the allotment of the road between the towns has upon the liability of the town of Central to bear its part of the expense of rebuilding the bridge, I have to say that the question seems not entirely free from doubt. It is held in the case of Commissioners of Union Drainage District v. The Commissioners of Highways, 87 Ill. App., 93, that: "An allotment of a town line road does not include bridges upon said road."

This decision was carried to the Supreme Court, and reversed on the ground that the validity of a statute was involved, and that therefore, the Appellate Court had no jurisdiction to render the opinion. (See case in 199 Ill., 80.)

The case was again carried to the Supreme Court on writ of error, and the judgment of the lower court affirmed, but the question as to the effect of an allotment of the road was not passed upon by the Supreme Court, but it is my opinion that a mere allotment of the road, as given in your letter, would not affect the liability of either town to bear its part of the expense of rebuilding a bridge on the town line road where there had been a joint agreement between the towns to build said bridge.

This opinion is in no sense official, and should not be so considered, but is rendered out of courtesy to you.

Very respectfully,
W. H. STEAD,
Attorney General.

1. Where, pursuant to statute, a town line road has been divided, and a portion thereof allotted to each town, each town must keep in repair the portion so allotted to it.

2. If, in pursuance of an agreement, each town has been keeping in repair its portion of a bridge, it can still be compelled to do so.

3. In the absence of agreement, no obligation rests on the adjoining town to undertake the repairing or building of bridges on town lines.

March 30, 1908.

Mr. Charles J. Richardson, Town Clerk, Davis Junction, Illinois.

DEAR SIR—In yours of the 18th inst., you state that you are having some dispute as to who shall keep up bridges on the town line; and that in 1857, the town line road between the town of Monroe and the town of Scott was divided into two road districts; that a part was allotted to each; that when the road was divided, the bridge did not amount to much but now the town of Scott needs some very expensive bridges on their part of the road. You ask me to advise you as to who is to keep these bridges in repair, and whether both towns are liable therefore, and what action to take.

In reply will say that I assume your county is under township organization. I also assume from your letter the following to be the facts:

In 1857 the town line road between the towns of Monroe and Scott was divided into two road districts; the portion of the road in each town being allotted to such town to be kept in repair; that a bridge was on the town line and that since the date of the allotment, each town has, by agreement expressed or implied, kept in repair the portion of the bridge located in its territory; that the town of Scott now needs some very expensive bridges on its portion of the road.

The allotment made in 1857 to the two towns, was made in pursuance of section 21, article XXIV, chapter 104, laws of 1856, page 1166. Section 21 is as follows:

"It shall be the duty of said commissioners when there may be such a highway to divide it into two or more road districts in such manner that

the labor and expense of opening, working and keeping in repair such highway through said districts, may be equal as near as may be, and to allot an equal number of said districts to each of said towns."

Section 22 of the same act provides:

"Each district shall be considered as wholly belonging to the town to which it shall be allotted for the purpose of opening and improving the road and keeping it in repair. * * *"

The allotment of the road, as described by you, did not carry with it any obligation with regard to bridges. The matter of the allotment of a road on a town line is one thing, and the matter of erecting and maintaining bridges on town lines or across town lines by joint action or agreement of the authorities of the two towns is another thing, and these questions, respectively, are governed by entirely different provisions of the statute.

If, in pursuance of an agreement, either express or implied, each town has been keeping in repair its portion of the bridge, it can still be compelled to do so. In the absence of an agreement, no obligation rests on the adjoining town to undertake the repair or building of bridges on town lines. People v. Supervisors, Ill., 527; Rutland v. Dayton, 60 Ill., 58; Dayton v. Rutland, 84 Ill., 279; Comrs. of Highways v. Comrs. of Highways, 100 Ill., 631; People v. Comrs. of Highways, 158 Ill., 208; Union Drainage District v. Comrs. of Highways, 87 Ill. App., 99.

Section 22 of the road and bridge act provides the manner in which adjoining towns may enter into contracts for the repair of old bridges or the construction of new ones. Section 23 of the same act provides that when commissioners of the adjoining towns refuse to enter into such joint contracts, the bridges may be built by the town requiring them, and the bonds issued therefor by such town.

In the case you submit, therefore, if the adjoining towns have by force of some agreement been keeping in repair each its portion of the bridge, it can still be compelled to do so, but if the town of Scott wishes to erect other bridges, in the absence of an agreement or contract, it can only do so in the manner provided by section 23. In other words, the law is as decided in the cases above cited, particularly the case of the People v. Commissioners of Highways, 158 Ill., 208, that in the absence of the contract between the commissioners of adjoining towns, there is no legal obligation resting on such adjoining towns to undertake the repair or building of bridges on town lines.

From consideration of the different cases bearing on this question, I am of the opinion that the town of Scott, if it wishes to construct new bridges, can do so if it follows the provisions of the road and bridge act, as hereinbefore pointed out, but it can impose no liability on the adjoining town to bear any portion of the expense unless such adjoining town sees fit to become a party thereto by a contract, as is provided in section 22, *supra*.

Very respectfully,

W. H. STEAD,

Attorney General.

TRACTION ENGINES.

Neither township nor commissioners held liable for any damage if traction engine breaks through a bridge.

Sept. 18, 1907.

Hon. A. N. Johnson, State Highway Engineer, Springfield, Illinois.

DEAR SIR—I have your favor of the 17th inst., in which you state that it is a fact that traction engines are in general use today, that are many times the weight of any load that formerly went over the public highways; that the weight of these modern traction engines is far beyond the capacity of many of the highway bridges; that it might be possible on some of the smaller bridges to brace such bridges in a temporary fashion so that these

heavy engines could pass over them in safety, but on the majority of bridges it means a total new construction which is practically out of the question for many townships to make.

You submit the question as to whether or not should a traction engine break through one of these bridges, the township officials would be liable to an action of damages at the suit of the person sustaining the injury.

A town is a local sub-division of the State established by the sovereign power of the State, and is clothed with but few corporate powers. Such powers exist only for the purpose of the general political government of the State, and are governmental in their character.

It is the uniform holding of the courts of this State that towns or counties are not liable to actions for neglect of duty, and have only been made liable by statute. Unless made so by express legislative enactment, towns are not liable to persons injured by the wrongful neglect of duty, or wrongful acts of their officers or agents done in the course of the performance of corporate powers, or in the execution of corporate duties. This principle is supported by a long line of decisions in this State. The following cases may be referred to: White v. Bond County, 58 Ill., 297; Russell v. Town of Steuben, 57 Ill., 35; Nagle v. Wakey, 161 Ill., 387; Kinnare v. City of Chicago, 171 Ill., 332; Town of Waltham v. Kemper, 55 Ill., 346; Elmore v. Drainage Commissioners, 135 Ill., 269; Symonds v. Clay County, 71 Ill., 355; Town of Odell v. Schroeder, 58 Ill., 353; Hollenbach v. Winnebago Co., 95 Ill., 148.

There is no statute making the town liable in such case, and I am of the opinion that under the facts submitted in your letter, the town in its corporate capacity will not be held reliable.

With respect to the personal liability of the highway commissioners, I would refer you to the case of Nagle v. Wakey, 161 Ill., 387, in which the court hold that where commissioners of highways have in good faith and to the best of their ability expended the means at their command upon the roads and bridges of their town, they are not liable to a person who is injured on one of the bridges in such town. This seems to be the only case which passed directly upon the personal liability of the commissioners of highways.

Very respectfully,
W. H. STEAD,
Attorney General.

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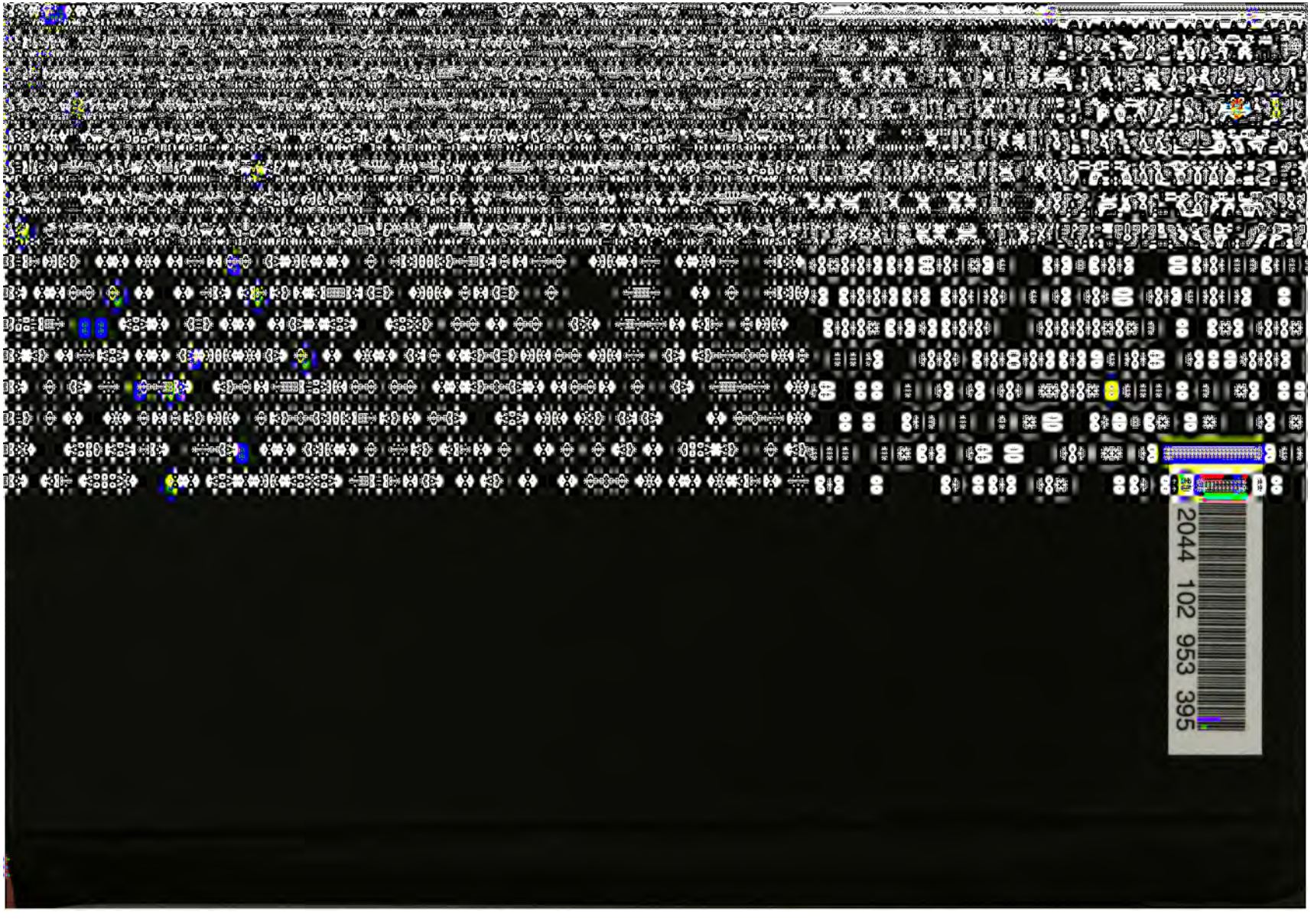
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